ENERGY FOR MY NEIGHBOUR

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anticipation

No. 28 December 1980

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Published in Boston for the World Council of Churches Sub-unit on Church and Society.
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Editorial Note

This issue of *Anticipation* has two parts. Part I contains a number of recent articles and papers on Energy Issues from the perspective of the developing countries. We publish these in preparation for a series of Asian, African, and Latin American regional meetings to be convened in 1981 by the WCC Energy for My Neighbour programme. Mr. Janos Pasztor who writes the introductory paper is Staff Consultant to Church and Society, WCC, Geneva for this programme. He is a recent graduate engineer from the Massachusetts Institute of Technology and an active layman in the Reformed Church of Hungary. The results of the regional conferences will be reported in later issues of *Anticipation.*

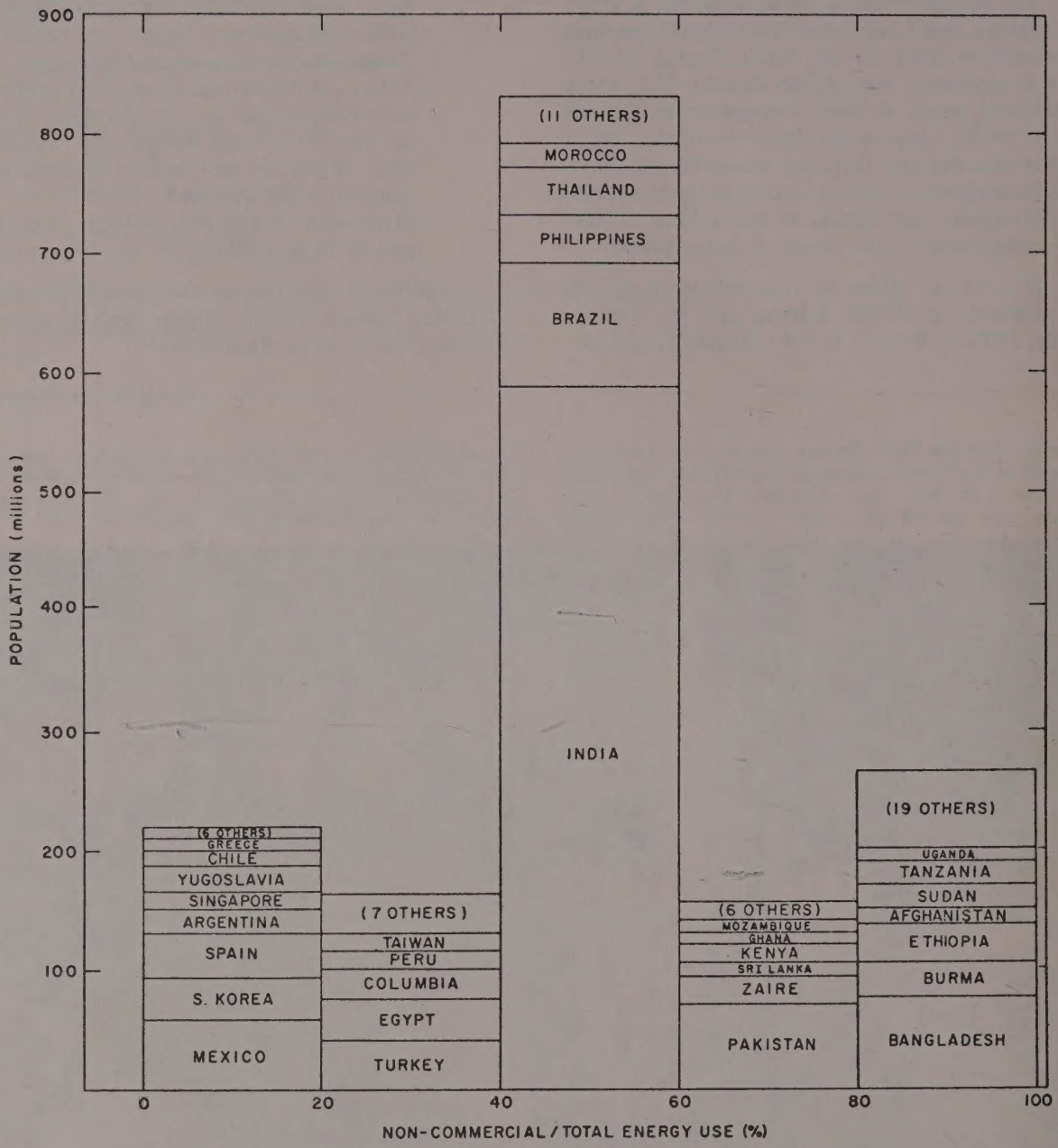
Part II concerns plans for the follow-up of the World Conference on Faith, Science and the Future, held in July, 1979, in Boston, U.S.A. Included here are:

- — Report on the 1979 Conference and Recommendations for Follow-up. Prepared by the Working Committee on Church and Society, meeting in Stuttgart, Federal Republic of Germany, June 1980.
- — Presentations to the Central Committee of the World Council of Churches, meeting in Geneva, August 1980 by Prof. Jonathan King (USA), Prof. Enilo Ajakaiye (Nigeria) and Metropolitan Gregorios (India) on behalf of the Committee on Church and Society.
- — Actions of the Central Committee approving the recommendations of the Working Committee on the Follow-up programme (including a WCC Statement on Nuclear Disarmament and Guidelines for Action.)
- — Meditation by Giles Ecclestone, given at Stuttgart in June, 1980.

Additional material on the ecumenical discussion of Faith, Science and the Future will be published in forthcoming issues of *Anticipation.*

Three participants in the Faith, Science and the Future Conference met again at the World Council of Churches Central Committee in Geneva in 1980. Paul Abrecht, center, talked with Janos Pasztor, new Church and Society consultant for Energy for my Neighbour, and Professor Enilo Ajakaiye, physicist from Nigeria. Mr. Pasztor's "Challenge to the Churches" sets the stage for the debate in Part I of this issue; Mrs. Ajakaiye's presentation before the Central Committee is found in Part II.

NONCOMMERCIAL ENERGY USE AS A PERCENTAGE OF TOTAL ENERGY USE, VS. POPULATION, BY COUNTRY



Sources: 1974 (est.) Population (Table 18, *U.N. Statistical Yearbook 1975.*); Commercial Energy Use: (*U.N. World Energy Supplies 1971-1975,* 1977); Noncommercial Energy Use: 400 kgce/rural population.

Women in rural village in Upper Volta bringing firewood from a distant forest. *United Nations*

Energy— A Challenge to the Churches

The last issue of *Anticipation* (no. 27) contained an article entitled, "The WCC Programme on Energy for my Neighbour—The Search for a New Look." That search is now well underway. We are taking seriously the emphasis of the 1979 World Conference on Faith, Science and the Future on the importance of participation by individuals and communities in the consideration of energy matters. Hence, we are laying stress on the churches' role in providing information which the public needs, especially on the ethical and social aspects of energy issues. Only in this way can the churches help people participate meaningfully in the choice of future energy options, and work for decisions which truly serve the whole of creation.

During the twelve months since the Conference at MIT the energy issue has become much more complex and controversial. One large international "mega-conference" follows another in taking energy as the main theme. Various "global reports" have appeared recently (e.g., that of the Brandt Commission) claiming that if nothing is done about the global energy situation there will be substantial shortages of certain fuels in the coming decades. These shortages will especially hit those Third World nations which do not have petroleum reserves of their own. In fact, energy has become such a basic commodity in modern societies that it seems unthinkable that the kind of energy-intensive life-styles we are used to may have to change in the future.

For the past few years the WCC discussion of energy has concentrated on the question of nuclear power. This has not diminished in importance, but the discussion has now broadened considerably. It is now well known

that one of the reasons the poor are short of energy is that the rich use too much. There are, however, no institutional channels through which energy could be transferred to the Third World on a large scale. In other words, we know what part of the problem is, but we do not yet know what to do about it. Living a less energy-intensive life-style by people in the industrialized countries is necessary, but not sufficient. Much more work has to be done on this problem, and the churches have yet to shoulder their responsibilities in this regard. This is especially true for the churches in the countries with high use of energy. For most of us in the rich nations the energy crisis still means the shortage of petroleum products. It must not be forgotten, however, that although many people are being hurt in these countries as a result of high energy prices, there is still a fundamental difference in what the energy crisis means for the rich and for the poor. For the former it may mean changing to a simpler life-style, using a smaller car, or travelling less. For the poor in Asia and Africa, however, the energy crisis means the inability to cook and to farm, which results in hunger, malnutrition and often death. Christians both as individuals and communities have a responsibility to do whatever they can to improve the *status quo* of the poor.

Presently the Third World uses about 10 percent of all the energy sources immediately traded in the world, such as coal, petroleum and uranium. This does not include the so-called traditional fuels, for example, cow dung, wood collected in the forest for personal use, or fuels such as charcoal traded at the local markets.

One of the most fundamental uses of energy is for domestic cooking. Over half of the present population of the earth is relying on traditional fuels for this purpose (see box on page 5). In the rural regions of Asia and Africa the energy required for domestic cooking represents a large proportion of the total energy use (in rural India this is 70 percent). This means that overall there still exists a very large number of people who satisfy most of their total energy needs from non-commercial or traditional fuels (see graph on page 2). These traditional sources of energy are renewable. Trees can be planted after forests are cleared, cattle can be grazed to produce more dung which can be burnt, and so on.

Recently, however, it has become apparent that these sources are not being renewed any more, as their rate of use has become larger than their rate of replenishment. A number of problems such as rapid population growth coupled with insufficient management of these resources have contributed to this situation. Commercial energy alternatives are not readily available for the very poor countries. Coal, which is plentiful in some countries, is difficult to transport to those regions where these problems exist. Distribution to users in rural Asia or Africa is even more difficult. Petroleum products, which would be the ideal alternatives, are becoming prohibitively expensive for those Third World countries which do not possess a reserve of petroleum of their own. In many areas, where people had switched from traditional to commercial fuels they are now forced to turn back to the traditional fuels. This is placing ever greater strains on these renewable resources. The forests of Asia are disappearing very fast and the badly needed cow dung instead of being used as fertilizer for agriculture is being burnt directly as fuel for cooking. The deforested land is usually incapable of supporting permanent agriculture and the grazing of animals, so it quickly erodes. The eroded soil ends up in the river and further downstream in the water reservoirs, which leads to large-scale floods. The lack of adequate forest cover is already causing local climatic changes, such as the changing of rainfall patterns. In addition, coupled with the large increase in atmospheric carbon dioxide mostly produced by the industrialized countries, it may result in irreversible global climatic changes such as the heating up of the globe. (This coupling is important, since forests absorb large amounts of atmospheric carbon dioxide.)

These problems are quite serious, but until recently this side of the energy crisis has been largely neglected by most of the organizations dealing with economic development as well as by the mass media. Many of the governments think that electrification and rapid industrialization are the solution, but for the rural poor this at most means that the electricity will pass above their heads in the high-tension transmission cables. Rural electrification is very expensive. To cook with that electricity would be prohibitively expensive for most of those living in the rural Third World. (This means 90 percent of Africans and 70 percent of Asians.) The question is, in view of the limited financial and material resources for rural development, what is the best way to supply energy?

There are a number of alternatives to central electrification, such as decentralized electric systems relying on small local grids with micro-hydro, wind, biomass-fired generators, and possibly photo-voltaics as sources. There are various other solar alternatives, such as reaf-forestation, use of bio-gas in various modes, etc. Many treat these energy sources as parts of integral systems of rural living, where energy, food, water, employment and "decent" living are treated as an integral whole. There are, however, a number of questions to be answered in addition to the technical aspects. These tend to center around cultural values, social acceptability, etc. A common problem with these energy technologies is that they are mostly designed in laboratories far removed from the situation where they will be used and the traditional cultural values are simply overlooked. The question of what constitutes a "decent" living and what kind of material resources will be required for this (including energy) will have to be looked at by the peoples concerned themselves. There exists a large number of groups working on these kinds of questions concerning rural energy in a number of Third World countries. The Ecumenical Movement seeks to help them organize themselves and to encourage cooperation between them at national, interregional and international levels.

The subject of the "new" and renewable energy sources is also being taken up by various intergovernmental development agencies these days. Even in the World

WORLD POPULATION BY PRINCIPAL COOKING FUEL, 1976*
(millions)

	Total	*Commercial Energy*	*Woodfuels*	*Dung and Crop Wastes*
Africa South of Sahara	340	35	215	90
Urban non-poor	30	25	5	—
Urban poor	20	—	20	—
Rural	290	10	190	90
India	610	60	290	260
Urban non-poor	60	40	20	—
Urban poor	70	—	40	30
Rural	480	20	230	230
Rest of South Asia	205	25	95	85
Urban non-poor	20	15	5	—
Urban poor	15	—	10	5
Rural	170	10	80	80
East Asia—Developing Pacific	265	95	110	60
Urban non-poor	55	40	15	—
Urban poor	30	15	15	—
Rural	180	40	80	60
Asian CPEs	855	190	435	230
Urban	205	150	55	—
Rural	650	40	380	230
Middle East—North Africa	200	105	35	60
Urban non-poor	70	70	—	—
Urban poor	20	10	10	—
Rural	110	25	25	60
Latin America & Caribbean	325	230	85	10
Urban non-poor	145	145	—	—
Urban poor	50	25	25	—
Rural	130	60	60	10
North America—OECD Pacific	365	365	0	0
Western Europe	400	400	0	0
European CPEs	340	340	0	0
Total	3905	1845	1265	795

* Copyright World Bank.

Bank, where traditionally over 99 percent of the energy investment went into centralized electricity, oil exploration and refining, there is now talk of funding projects for firewood. The United Nations is holding a world conference with 4000 participants on the theme "New and Renewable Sources of Energy." This meeting is to take place in Nairobi in August 1981. The WCC Energy for My Neighbour Programme (ENP) will take part as an official participant at the Non-Governmental Organization's Forum during the conference (see box).

It is therefore clear that the WCC deliberations about the ENP will have to take place in the light of these events. Already at the MIT Conference it was proposed that there be consultations in Africa, Asia and Latin America on energy. The staff has since discussed this possibility with various contacts in the Third World. A plan was approved to hold a number of consultations on the theme "Just Energy Policies for Sustainable Societies in the Third World." The aim of these consultations will be to explore:

—Present energy needs and problems in the regions, especially in the rural areas;
—present energy policies and technologies and their social consequences;
—social, political and economic obstacles to the appropriation of new energy options and the social changes required to overcome these obstacles;
—priorities at regional/sub-regional level for short- and long-term work including local action programmes and projects;
—ethical issues related to energy of particular concern to the churches and community groups;
—possibilities for ecumenical, intra- and inter-regional cooperation in the field of energy;
—responsibility of the First and Second World peoples.

Plans are already underway for the first consultation to be held in India by the end of January 1981, followed shortly by another one in the Far East. During the spring of 1981 there would be two or three consultations in Africa, followed by one or two meetings in Latin America at the end of the summer. Late in 1981, there would be a "mini summit" for participants from each of these regional consultations to summarize the results and write a report for the Central Committee of the WCC in 1982 on the Churches and the Energy Crisis in the Third World.

As preparation to this inquiry, the first part of this issue of *Anticipation* is devoted to energy problems of the Third World, especially Asia. The first two articles deal with bio-gas. The first one, written by Amaratunga of Sri Lanka discusses the possibility of an integrated farming system which is based on bio-gas as a source of energy. Dandekar of India brings up the issues concerning the social acceptability of bio-gas in the Indian rural context in the second article. Juyal, also of India brings the question of the deforestation of the Himalayas into a political and historical context. The following article written by Egan of the U.S. and Arungu-Olende of Kenya challenges the nuclear industry with some questions concerning nuclear power for the Third World. Next is a communiqué from the Center for Law and Social Policy in Washington, D.C. about the export of a nuclear reactor from the U.S. to the Philippines and the problems associated with it. Energy as a major security issue is the subject of a public lecture given by the Kenyan journalist and nuclear physicist Hilary Ng'weno. The last article was reprinted from the official publication of the United Kingdom Atomic Energy Agency, the *Atom* which presents their view on the energy crisis in the Third World.

JANOS PASZTOR

Cow dung being prepared to be used in place of fire-wood in Varanasi, India. *United Nations J.P. LaFonte*

United Nations Conference on New and Renewable Sources of Energy

The main objective of this conference, to be held in Nairobi, Kenya in August 1981 is to elaborate measures for concerted actions designed to promote the development and utilization of new and renewable sources of energy, with a view to contributing to meeting future overall energy requirements, especially those of developing countries, particularly in the context of efforts aimed at accelerating the development of developing countries.

The rapid depletion of conventional energy resources and the growing demand for energy by countries throughout the world has made the search for new and renewable energy sources imperative. The conference and its preparatory process will provide the opportunity for countries to examine closely what can be expected from alternative sources of energy in the next decade and enable governments to make policy decisions concerning their energy requirements.

The conference will deal with *14 energy sources.* Eight panels of international specialists nominated by governments and appointed by the Secretary-General on the basis of equitable geographical distribution are studying, respectively: solar; geothermal; wind; tidal, wave and thermal gradients of the sea; biomass conversion; fuelwood and charcoal; oil shale and tar sands; and hydropower. Two consultant studies, one carried out by the government of Finland and the other by a distinguished Indian specialist will examine, respectively, peat and draught animal power.

The panels will meet twice. The first round of meetings have already been concluded and the second will be convened between September 1980 and January 1981, after which a group composed of the chairmen of the panels and other energy experts will synthesize their conclusions on a comparative basis.

Preparatory Committee: The Preparatory Committee for the conference is open to participants from all Member States. The first Preparatory Committee met from 4-8 February 1980; the second from 21 July until 1 August 1980. They considered preliminary responses to the questions of current usage and potential of new and renewable sources of energy in the world, the state of existing research and development of these sources worldwide, and made recommendations to the General Assembly for the agenda of the conference.

Special Studies: Six expert groups will concentrate on issues that cut across all energy sources and panels: transfer of technology, financing, information flows, industrial issues, energy storage, and rural energy. Other cross-sectional issues such as the education and training required to significantly enhance the use of new and renewable sources of energy, the socio-cultural constraints upon such use, and the environmental impact of increased use of these sources will be explored in co-operation with the organizations of the United Nations systems concerned.

Technical Assistance: The organs, organizations, and bodies of the United Nations system will provide assistance to individual developing countries upon request to aid them in their preparations for the conference at the national level through their national focal points.

National Papers: National documents embodying country positions on new and renewable sources of energy will be prepared by member governments as part of the national level preparatory process if through current consultation with the members it is concluded that governments do in fact wish to have such documents prepared.

National Focal Points: Countries have been requested to designate national focal points (individual organs such as departments of energy or multi-disciplinary committees) which will co-ordinate preparations for the conference at the national level and act as liaison between the individual countries and the conference.

I
Bio-Gas in an Integrated Farming System

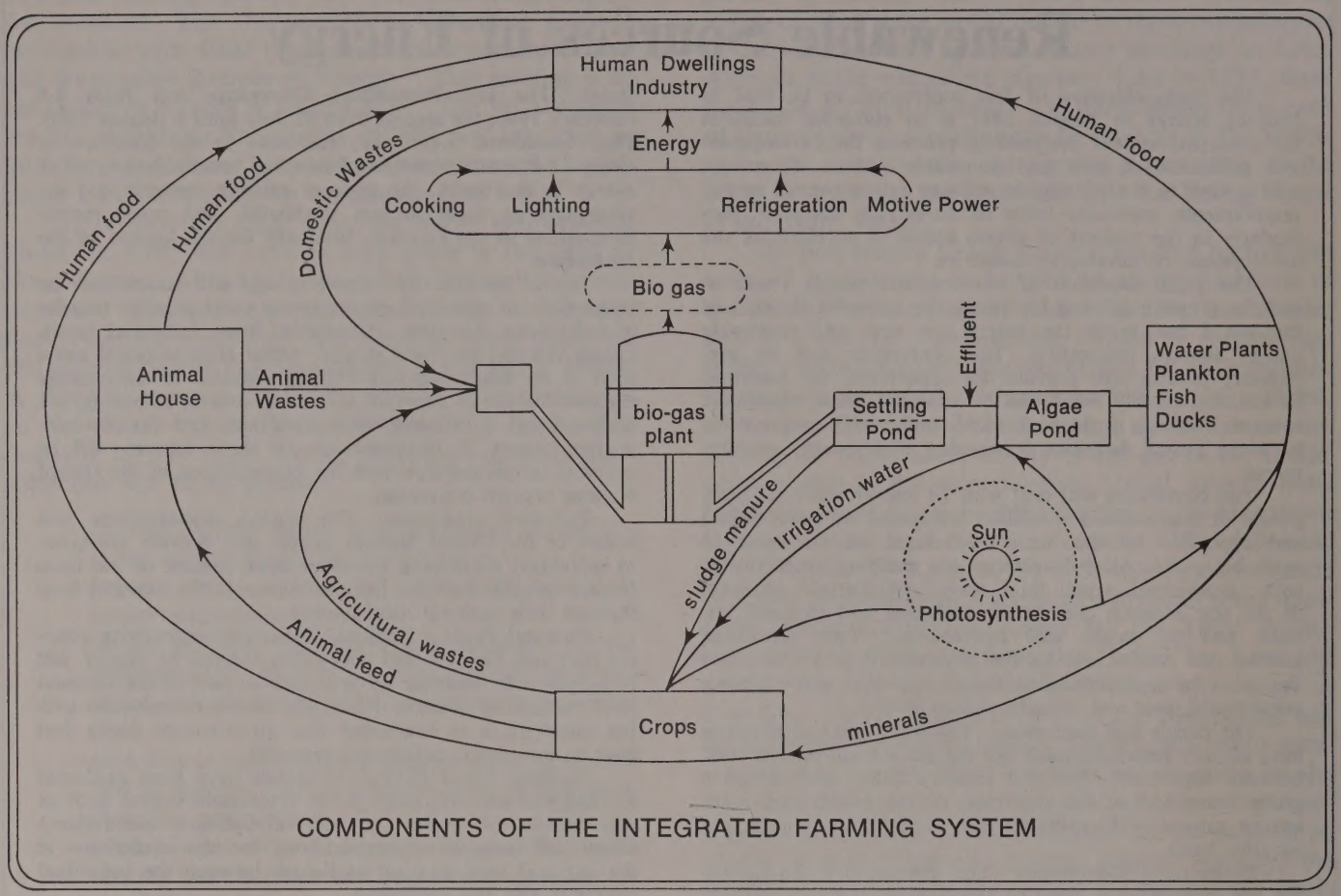
Reprinted with permission from the Vol. I, No. 1, 1977 issue of *Agricultural Engineering,* Peradeniya, Sri Lanka.

M. Amaratunga

The results of some studies in population growth, land usage and energy requirements in Sri Lanka are summarised briefly in order to highlight the very grave situation the country is likely to face in the foreseeable future with regard to supplies of food, fertilizer and fuel. The concept of an integrated farming system is presented as a valuable proposition for solving these problems, if not as the sole means of survival through self-reliance at rural levels.

The bio-gas unit is treated as the core of the system, but its benefits are shown to comprise not more than about 30 percent of the total available benefits of the whole system. When considered independently, bio-gas units may not always be economically viable.

The basic data from which a bio-gas unit can be designed are presented along with the results of some investigations into the production of gas from local raw materials.



COMPONENTS OF THE INTEGRATED FARMING SYSTEM

1. INTRODUCTION

Although it was becoming more and more apparent that there exist certain limits to growth, it was not until the sudden increase in oil prices in October 1973 that serious attempts were made to reduce the growing dependence on the non-renewable resources of the earth. Interests in the utilisation of solar energy, wind power and bio-gas (SWB) then received an unprecedented boost. Of these three unconventional forms of energy, bio-gas technology with its multi-fold benefits appears to offer the greatest potential for application in a tropical country with a considerable rural population such as Sri Lanka.

Gas produced in sewage works has, of course, been used for many years in industrialised countries for the production of electricity to meet the requirements of the sewage plants. In some countries, notably in China and India, development of bio-gas digesters suitable for supplying the energy requirements of rural homes has been going on since the 1950s. In China, in the province of Szechuan, 60,000 units had been installed in a short period of two years and 20,000 more were to be installed by the end of 1975, providing almost the whole of the province with bio-gas. About twelve more provinces are stated to be implementing similar programmes. In India, about 20,000 family-sized digesters had been installed toward the end of 1975 of which about 70 percent had been built since the oil crisis. Within the next five years, India plans to build 100,000 such units. A considerable amount of research work has been done in Japan on the biological fermentation process although the country has no real need for family-size bio-gas units. The results of these investigations, which have been published in Japanese, have been made use of in the Republic of Korea where 29,000 domestic units had been established by 1975.

In the wake of the fuel crisis various international organisations too began to devote their attention to the technology and utilisation of bio-gas. The Economic and

Social Commission for Asia and the Pacific (ESCAP) at its thirtieth session in Colombo in 1974 decided to take appropriate action in the fields of energy and fertiliser as a matter of priority and the United Nations Development Programme approved a project to collect and disseminate information on the bio-gas industry. Subsequently, a workshop on bio-gas technology and utilisation was held in New Delhi in July 1975 followed by a second one in Manila in October 1975. The United Nations Environment Programme is supporting the establishment of Rural Energy Centres throughout the world and the first one in Asia is to be set up in Sri Lanka at Pattiyapola in the Hambantora area. This model SWB project envisages the use of a 35 m^3 (3000 ft^3) bio-gas plant for the generation of 40,000 kWh of electrical energy per year.

Very few bio-gas units exist in Sri Lanka today. In 1973, the author set up a laboratory model at the Peradeniya Campus of the University of Sri Lanka for experimental purposes. This unit has been used in undergraduate experiments illustrating the application of equipment such as the Boy's calorimeter and Orsat's apparatus. The Industrial Development Board is attempting to popularise the use of bio-gas by establishing such units in schools and has undertaken a programme for establishing about 25 generators. Generators have already been established in Colombo, Matara and Badulla; the first one in Kandy is being set up in collaboration with the Faculty of Engineering of the Peradeniya Campus. The People's Bank too has shown much enthusiasm in popularising the use of bio-gas and is financing the establishment of a pilot unit. Other organisations such as the National Institute of Management and the Sri Lanka Tobacco Industries Corporation too have investigated the feasibility of utilising bio-gas. The Department of Agricultural Engineering of the Peradeniya Campus intends to carry out a field study of bio-gas utilisation at its proposed Agro-social Laboratory.

2. POPULATION GROWTH AND LAND USE

2.1 Population growth forecasts

Any investigation aimed at improving the quality of life of a community must take into account the increase in numbers of that community. Detailed research studies of Sri Lanka's population changes have been carried out as part of a larger series by the Population Council in New York (Frejka). The basic assumption made in these studies is that the population growth will eventually become zero. Frejka has obtained computerised results of population projections based on more recent theories on the subject. Assuming four different degrees of population control, which may be described in general terms as drastic, intensive, moderate and mild, the population of the country is expected to increase by the year 2100 to 23, 31, 41 and 54 million, respectively.

2.2 Land use

The amount of cultivated land per capita has been falling throughout this century from about 2,600 m^2 per person in 1910 to around 1,400 m^2 per person today. The output from the land is not nearly acceptable, taking into account the considerable amount of undernourishment in the country. Since the total land area is only 6.5 million hectares the land available might not be adequate to sustain the country's population by the end of the century, whatever attempts are made to open up new lands for cultivation, if present-day techniques of production continue. If the area of land required to provide feed material for the increase in livestock populations is also taken into account together with other additional demands on usable land for housing, roadways, reservoirs, etc., the maximum area of agricultural land per person will be of the order of 1,600 m^2 by the year 2000. In order to maintain the fertility of this land—a fertility that is fast declining—an enormous amount of fertiliser will be required. It would therefore appear that an approach different to the present trends will be required as regards the utilisation of land and other resources.

3. ENERGY DEMAND AND SUPPLY

3.1 Electricity

Fernando gives the results of a study of electrical energy demand based on an overall growth rate of around 10 percent. This might more appropriately represent a latent growth rate because various factors tend to suppress the growth. A real growth rate of 4 percent on domestic and general purpose demands and 3 percent on all industrial demands have been used by the author to estimate a lower limit forecast. The supply of electrical energy from renewable resources, represented by the hydro-energy components has been estimated at 5,700 GWh per annum, but this should be treated more as giving an order of magnitude of what is attainable regardless of cost. Also there is a considerable degree of uncertainty of such hydro-energy estimates, as these will be affected by changes in rainfall patterns and water management. The supply from the more feasible projects will depend on the progress in implementation which will in turn depend on the investment funds available.

It is expected that there might be hydro-energy shortages from the beginning of 1978. According to the author's forecast, these shortages will occur in 1985, unless the Canyon or another project materialises by that time. In all probability, the demand will exceed the supply position in the early 1980s unless the Samanalawewa or Kotmale projects get under way. The alternative will be a heavy dependence on the non-renewable thermal support, which in any case is limited to 250 GWh per annum at present.

3.2 Fossil fuels and firewood

Petrol and kerosene oil have shown about a five-fold increase in price during the period 1965–1975. The country still imports all the requirements of this type of fuel and an increase in demand will result in greater pressures on land required to produce exportable commodities.

Very little thought appears to have been devoted to the ever-decreasing supplies of firewood and the real possibility of denuding forest lands. In the past few months there has been a number of alarming reports that branches of fruit trees and even coconut trees are being felled for use as firewood. The cost of firewood even in rural areas has shown almost a threefold increase during the past decade. This increase, viewed on its own, may not appear to be out of proportion to price increases in general. However, when considered in the light that firewood was at one time a commodity which was not sold but was freely available under trees to be picked up by anyone who required it, this price increase is a considerable one. A survey of the use of fuel for domestic purposes in some areas around Peradeniya shows the following trends:

(i) supplies of firewood are obtained from much greater distances than in the past and the problem of transportation is becoming more and more acute every year;
(ii) there is a growing tendency to cut branches of fruit trees such as avocado, mango and durian during the "off-season" for use as firewood;
(iii) materials which were normally allowed to rot and enrich the soil are now burnt as fuel. Paddy husk has become a popular fuel and costs Rs. 2/- per gunny bag;
(iv) there is a growing tendency once again to use kerosene oil for cooking because of the difficulty and expense involved in obtaining other fuels.

Such trends may well apply to many parts of the country and will surely result in a very grave and irremediable situation in a few years time.

4. THE CONCEPT OF AN INTEGRATED FARMING SYSTEM

4.1 Simultaneous production of food, fertiliser and fuel

With the decreasing area of agricultural land per head of population together with an increasing demand for food, fertiliser and energy, the problems likely to be encountered by the mid-1980s seem to be almost insurmountable. An increase in food production will necessitate an increase in the production of fertiliser which in turn will require the use of vast amounts of energy. In such a context, a system such as the one described below, which has the potential for providing food, fertiliser and energy in a confined space, needs urgent consideration.

A diagrammatic representation of the concept of an Integrated Farming System (IFS) is shown. The system, as envisaged here, makes full use of nature's own processes of photosynthesis and bio-degradation. The bio-gas plant represents the core of the system and the success of the entire operation depends on the efficient functioning of this unit. There is enough know-how in the country to enable the design and construction of these units to be carried out and the technology required is available in any rural area in the country. A more specific discussion of this plant is given in section 5 below. The incorporation of more recent trends such as algae culture and fish culture in inland ponds forms an essential part of the integrated system if maximum benefits are to be derived.

In recent years, IFS projects have been initiated in a number of countries. In 1970, Chan (personal discussion) commenced work on a project in Fiji which he has operated successfully. Papua - New Guinea too is stated to have an on-going project started by Chan. Thailand has proposals for setting up a project at Prom-Buri. India's first project, which is perhaps the largest of its kind yet, is sited at Pondicherry on the 40 hectare Gloria Farm. This is sponsored by the Sri Aurobindo Ashram trust and is estimated to cost Rs. 500,000/-. The immediate commencement of a few small-scale projects in Sri Lanka appears worthwhile, judging by the analysis given in the following section.

4.2 An economic appraisal

The output from a 1 hectare (2½ acre) extent of land, with a herd of 5 cows and 3 calves forming the primary farm animal unit, is investigated below. Only the additional economic advantages obtainable from an IFS scheme, which would otherwise go to waste, are considered. The proposed utilisation of this area of land is as follows:

Shelter for humans	:	200 m^2
Shelter for animals	:	50 m^2
Other buildings	:	100 m^2
Bio-gas plant and settling pond	:	50 m^2
Algae ponds	:	200 m^2
Fish ponds	:	500 m^2
Allow for pathways, etc.	:	900 m^2
Agricultural fields	:	8000 m^2

The estimates of the yields from the non-conventional sources, made possible by the bio-gas plant, are worked out below using extremely low rates as compared with those reported in other countries.

Fertiliser

The anaerobic digestion increases the available nitrogen content of cattle manure from about 0.8 percent to about 2 percent, besides improving the overall quality. Indian experience has shown a 25-35 percent increase in the yield of crops, fed with the spent slurry from bio-gas plants, when compared with those fed with composted cattle manure. A 10 percent increase in crop output is assumed here which is taken as equivalent to an extra 500 kg of produce valued at Rs. 500/ - per annum.

Algae ponds tonnes/hectare per year

Commercial production in the U. S. A.	:	1000
Production in Asian countries	:	125
Assumed local yield	:	25

The protein content of algae is over 40 percent on a dry weight basis and it can be as high as 80 percent. The annual yield from the algae pond will be about 500 kg which will save at least Rs. 100/- per year on animal feed.

A bio-gas digester (above) is being designed by Professor Amaratunga and his colleagues at the University of Peradeniya in Sri Lanka.

Fish ponds

tonnes/hectare per year

Commercial production in the U.S.A. (rainbow trout)	:	2000
Intensive culture in Japan (carp)	:	4000
River culture in Indonesia	:	500
Local yields, Department of Fisheries, (common carp, tilapia, gouramy)	:	3

The annual yield from the fish pond will be about 150 kg valued here at Rs. 500/-. The fish pond can also sustain about 100 ducks valued at (say) Rs. 300/- per annum.

Bio-gas

Although the total potential for gas production is over 4 m^3/day from the human and animal wastes alone, a usable quantity of 3 m^3/day is assumed to be available. Using a conversion efficiency of 50 percent for a kerosene cooker and 60 percent for a gas cooker, 1.62m^3 of bio-gas may be considered to be equivalent to 1 litre of kerosene oil. The value of fuel, based on the current price of kerosene oil, is therefore Rs. 640/-.

The above analysis which has been based on very low yields from the algae ponds and fields show that the fuel output represents not more than about 30 percent of the total financial benefits of the IFS concept. The actual proportion will, of course, depend on the individual project. Other benefits, such as improved sanitation, have not been considered in the above analysis. The above figures also show that the fish pond provides the greatest potential for exploitation.

5. DESIGN OF BIO-GAS PLANTS

5.1 Some common misconcepts

There is still a widespread belief that bio-gas can be produced only from cattle dung. The reason for this is perhaps the fact that most of the initial information on the subject came from India where bio-gas was popularised under the name gobar gas (cow dung gas). There is also a belief that liberation of the gas renders the dung useless as a manure. The mere use of the word gas appears to convey a picture of the use of sophisticated technology both in the production of the gas as well as in the use for domestic purposes. In the minds of some, gas is associated with explosions and hence danger. The brief descriptions given in the sections below will help to give a general idea of the technology and the basic principles involved.

5.2 The fermentation process

Bio-gas is the result of anaerobic fermentation of organic matter by a group of micro-organisms, commonly referred to as methane bacteria. These are found in the intestines of animals and the use of cattle dung is perhaps the easiest way of obtaining these bacteria in this country. It can be shown that the methane liberated from waste organic matter derives part of its hydrogen from the water used in the mixture.

5.3 Composition of bio-gas

The composition of the gas depends on the type of organic matter used, the prevalent type of bacteria, the temperature and the period of decomposition. The following figures will give an idea of the composition of a typical sample of gas:

Methane	:	50–70 percent
Carbon Dioxide	:	25–45 percent
Nitrogen	:	0– 3 percent
Oxygen	:	0– 1 percent

Traces of hydrogen and hydrogen sulphide are also liberated. The higher values of carbon dioxide, quoted above, were observed when freshly picked water weeds and fresh green grasses were used, particularly during the early days of the fermentation process.

5.4 Composition of the spent material

The composition of the spent wastes will depend on the composition of the materials fed into the digester and the period of retention. With regard to the fertiliser value of the spent material, the available nitrogen content is increased more than two-fold when compared with composted cattle manure. The spent slurry is ideally suited for feeding directly into the fields with irrigation water. For periods of retention greater than 30

days, the spent slurry resulting from an input of cattle dung was always found to be free of weed seeds. For lower retention times, there was a tendency for a certain amount of weed germination to take place. More investigations are required on this aspect of weed destruction, but the weed-free nature of plots manured with digested dung is quite evident.

5.5 Effects of temperature

The optimum temperature range for the bacterial fermentation process is 30°–35°C. Below 10°C and above 50°C, the bacterial function is almost completely destroyed. Sri Lanka is most fortunate in this respect because near optimum conditions are obtainable throughout the country almost all the year round.

It was observed in the laboratory investigations at Peradeniya that gas production dropped, coming almost to a standstill at times, whenever night temperatures fell a few degrees below day temperatures. When the lower temperatures persisted for 2 or 3 days, however, the reaction tended to pick up gradually. This seems to indicate that sudden temperature changes are detrimental to the fermentation process and that the process can adapt itself to changed conditions, given sufficient time. Further investigations are needed for the confirmation of this observation.

Various solar reflectors for cooking are being designed by Prof. Amaratunga and his colleagues at the University of Peradeniya in Sri Lanka.

5.6 Effect of pH

The growth of methane bacteria is retarded in an acid medium and the liberation of gas may stop if the digester contents become too acidic. A pH range of 6.0 to 8.0 is usually tolerated but a slight alkalinity is to be preferred so that the risk of acidic failure is eliminated. Acidity was an occasional cause of failure of the small glass digesters used by the author. Although pH may be controlled by the addition of lime, dilution of the digester feed with water is preferable. This procedure helps to minimise the risk of other toxic materials building up in concentration.

5.7 Effects of various materials

Oxygen, ammonia, chlorine and hydrogen sulphide are among the other materials, likely to be encountered in digester contents, which tend to be toxic to methane bacteria and therefore their presence must be minimised. Carbon dioxide and nitrogen are essential for bacterial growth but the carbon to nitrogen ratio should not exceed 30. Excessive amounts of air in the gas holder was a frequent cause of slow starting from a fresh batch of digester feed, but this difficulty can be easily overcome by seeding the digester input with some spent slurry, if this is available, or by emptying the contents of the gas holder regularly during the first few days.

5.8 Effect on pathogens

The sanitary aspect of anaerobic digestion is not always appreciated. With a retention period of 30 days or more, all pathogens are stated to be destroyed. If bio-gas technology catches on, its effect on rural sanitation, particularly in regard to the reduction in the occurrence of bowel diseases, can be dramatic.

5.9 Design of the digester

The design of the digester will depend on the relative degree of importance attached to the various components of an IFS project. The digester may be designed to take in feed material daily or at regular intervals without the need to empty the contents manually (continuous operation), or, alternatively, the feed material may be enclosed in a digester until a required degree of fermentation has taken place and then emptied out and replenished (bath operation). Some means of stirring the digester contents is necessary to improve the liberation of gas.

5.9.1 Continuous type of digester

Digesters designed for continuous operation are suitable when a regular supply of wastes can be ensured e.g. in a cattle farm, a hospital or a hostel. The capacity of the digester will be determined by the amount of gas required and the retention time that is considered desirable. When human wastes are used, periods of retention well in excess of 30 days are desirable, unless the spent sludge is to undergo further treatment, in order to minimise the chances of survival of harmful bacteria.

Since fresh waste materials fed into the digester carry some free oxygen, there will be a region around the inlet where anaerobic conditions cannot exist. The size of the digester will have to be chosen with due regard to this effect. A two-compartment digester will have the advantage of isolating the inlet region from the areas where anaerobic effects prevail. The incoming material displaces an equal volume of spent material and therefore a certain amount of automation is possible with this type of digester.

5.9.2 Design of the gas holder

When the supply of wastes is not regular or the quantity available on a regular basis is inadequate, batch operation may be used. The digester is made to any convenient size and a battery of these used to obtain the quantity of gas required. Thus the risk of the breakdown of a gas supply due to acidity or other toxicity is greatly reduced. Also, the period of retention of a given batch can be strictly controlled, which is an advantage when different waste materials are to be used. The need to load and unload the digesters at intervals is, however, a disadvantage. This type of digester is useful when the bulk of the wastes consists of vegetable matter, animal wastes being used to obtain the methane bacteria.

5.10 Design of the gas holder

The gas holder is currently the most expensive single item of the whole system, estimates for the commercial manufacture of 3 m^3 holders being

(i) 18 gauge mild steel drum : Rs. 2,500/-
(ii) 3.5 mm pvc drum : Rs. 4,725/-
(iii) ⅛ inch rubber bag : Rs. 1,630/-

(The rubber holder has been specially designed by the author, but has not been tried out in practice.)

The capacity of the gas holder may be taken as two thirds the volume of gas consumed per day, if the bulk of the consumption takes place once a day. If the consumption is fairly evenly spread out throughout the day, a storage capacity of about one half the day's consumption will be adequate.

The basic requirement of the gas holder is that it should store a sufficient quantity of gas for use when required. When a drum type of holder is used, the technique that is frequently used is to collect the gas over water, the open end being sealed by the water. A suitable guide is provided to enable the drum to move vertically up and down freely as the gas volume changes. One of the better designs, developed in India, makes use of the drum to provide a cover to the digester, the gas holder moving up and down in the digester slurry. This technique has the added advantage that the gas holder can be used to stir the digester contents to prevent scum formation and to enhance the liberation of gas.

5.11 Design data

The rates of gas consumption for different purposes and the rates of gas liberation for various materials are necessary for the estimation of the capacity of the digester and the gas holder. These are given in Tables 1 and 2 below and apply to temperature ranges normally encountered in Sri Lanka. The consumption rate for cooking takes into account the typical cooking habits of the people.

In view of the high degree of variability of the composition of the raw materials, precise figures have little meaning, but the values below are good enough for design purposes.

Use	Consuming unit	Gas consumed (m^3)
Cooking	1 adult	0.23–0.34 per day
Lighting (gas)	100 c p gas mantle (40 W)	0.13–0.17 per hour
Motive power	1 h p engine	0.43–0.51 per hour
Electrical power	1 kW generator	0.62–0.77 per hour

Table 1. Bio-gas requirements for various applications.

Raw material	Time for full digestion (days)	Design yield for 60 day retention (m^3/day)
Human wastes	15–20	0.0285/person
Cattle dung (wet)	100–120	0.0342/kg
Rice straw (coarse)	90–100	0.25 /kg
Rice straw (fine)	80–100	0.31 /kg
Salvinia	20–30	0.12 /kg
Water hyacinth	20–30	0.12 /kg
Grass	20–30	0.13 /kg

Table 2. Bio-gas yields from various raw materials.

6. FUTURE WORK

The establishment and operation of a few pilot projects will undoubtedly indicate areas in which further research and development work needs to be carried out under conditions prevailing in the country. The following topics, however, need early investigation and can be undertaken without much equipment or expenditure:

1. Development of an economical gas holder, e.g., a rubber balloon.
2. Investigation of gas yields of more varieties of raw materials.
3. Investigation of gas yields of various combinations of raw materials.
4. Influence of high temperatures, obtainable by glass house effect.
5. Development of inexpensive but efficient gas appliances.
6. Influence of time of digestion and temperature on pathogens and weed seeds.
7. Hardness of seeds surviving fermentation process.
8. Influence of pressures on fermentation process.
9. Comparative studies of batch and continuous operation digesters.
10. Socio-economic aspects of bio-gas technology.

Investigations of this nature can best be undertaken by a multi-disciplinary team, but the leading roles might have to be played by those with a knowledge of Agricultural, Civil and Mechanical Engineering.

7. CONCLUSIONS AND RECOMMENDATIONS

In the rural areas of Sri Lanka, bio-gas technology can offer the people an improved quality of life through recycling waste materials, which represent a renewable resource. The present trend in the country to look upon bio-gas generators as means of providing fuel only needs to be corrected as such units are not economically viable for domestic purposes, unless future work results in the development of an inexpensive gas collector. What needs popularising is the concept of the Integrated Farming System and there is enough expertise in the country to embark on a few pilot projects. Besides the more tangible immediate benefits of meeting the demand for fertiliser, food and fuel, there are more fundamental benefits that will accrue, such as cleaner homes, improved rural sanitation, conservation of trees, improvement of the soil and, above all, the development of a spirit of self reliance.

In view of the multi-disciplinary nature of the work involved, a strong recommendation is made for the grouping together of a team comprising agriculturists, botanists and engineers within an Integrated Bio-gas Development Centre with facilities for co-opting scientists with specialist knowledge in related disciplines.

II

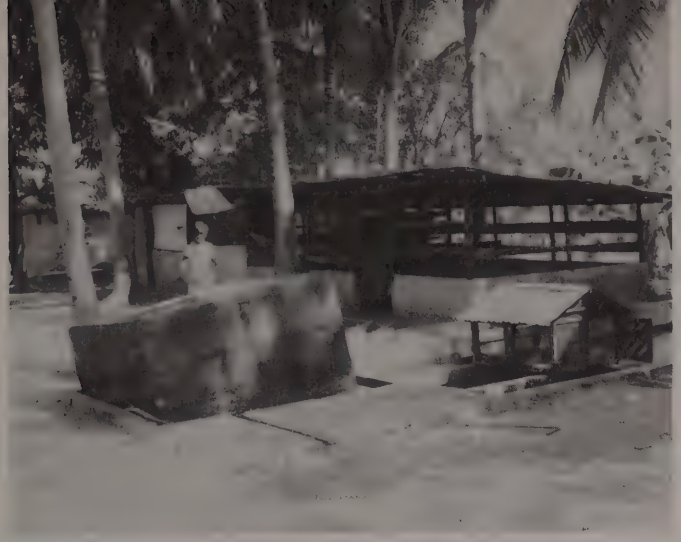
Gobar Gas Plants: How Appropriate are They?

Reprinted with the permission of the May 17, 1980 issue of *Economic and Political Weekly*, Bombay, India.

Hemalata Dandekar

The technology of producing methane gas from cow dung and other wastes and using it as fuel for various purposes has received considerable attention in India during the last decade. In the light of the growing energy shortage that the country faces gobar gas is being cited as having great potential for answering the energy needs of rural areas. In this climate it is relevant to explore the desirability of gobar gas technology from the village perspective since, after all, it is the farmer in the countryside who ultimately decides whether or not to invest in a gobar gas plant.

This paper, based on the responses of residents of a village in Satara district called 'Sugao', attempts some general statements regarding the constraints on the adoption of gobar gas technology in rural areas. Its findings are that social, spatial, cultural and attitudinal criteria are as important as technical ones in the assimilation (or rejection) of new technology.



The picture above shows a bio-gas digester in the village of Christa Illam in Sri Lanka.

During the past decade, Indian government agencies such as the Khadi and Village Industries Board and private voluntary groups have promoted gobar gas plants as an important component of their rural development strategy. Indian planners consider this to be a technology which, if disseminated widely enough, has the potential to deliver major benefits and improve rural living conditions. The advantages cited can conveniently be listed under four heads:

Benefits of Gobar Gas

Simplicity and Utility: The basic process of gobar gas generation is relatively simple and does not require very sophisticated equipment or know-how.[1] Once the unit is constructed it uses primarily local resources (raw materials and labour) and creates products that are extremely useful in the village (fertiliser and fuel). The methane gas produced can be used for a variety of purposes: cooking, lighting, and driving machinery such as water pumps.

Optimal Allocation of Resources: Villagers frequently collect and dry animal dung and organic plant wastes for use as fuel (as in cooking). It is estimated that 30 percent of the country's fuel needs are met by burning cattle dung and another 34 percent by burning agricultural residues. Not only is this procedure an inefficient way of generating heat, it also uses up valuable nutrients that could have been applied to the soil. The denudation of forests and stripping of hillsides causes further problems. In contrast, although the process of gobar gas generation reduces the volume of organic wastes by 20 percent, the gas produced gives 120 percent of the heat that would be generated by burning the cow dung. The wastes can then be used as fertiliser; moreover, some proponents claim that their nitrogen and phosphorous content is enhanced, thus producing a better soil additive.

On the national level the increased use of dung for fertiliser and decreased deforestation that should result from widespread adoption of gobar gas technology would be a clear benefit.

Improved Health: The various types of waste which today litter and fester in the lanes and houses of villages will be collected, rendered innocuous and used for manure. Flies and other insects thrive on this matter today and reach epidemic proportions in some seasons causing many health problems. This nuisance should be considerably reduced as standards of hygiene rise with the sanitary disposal of wastes.

The majority of houses in rural India do not have facilities for disposal of human waste. Generally, people go to designated fields adjacent to the village to relieve themselves. Excrement can thus be carried around by human feet or on the hooves of pigs and cattle that graze in these fields and consume it and thus contaminate food or water. In fact, sometimes these areas are close to sources of water and through seepage, human excrement can contaminate drinking water. Gobar gas plants with attached toilets would facilitate the sanitary disposal of human waste.

Health benefits would also accrue in the home. In most rural households, cooking is presently done on wood- or dung-burning clay stoves that do not have chimneys. Inevitably, during cooking, kitchens fill with smoke and village women frequently have eye problems as a result. Often the kitchen is the only room of the one room house and so smoke affects the health of not only the housewife but all the family. The clean burning gas provided by the gobar gas plant would change this and result in healthier living quarters for the rural family.

Savings to Villagers: One energy source used in villages is kerosene, but this has become scarce and expensive in the wake of rising petroleum prices. Gobar gas would be a suitable alternative. Since it burns cleanly, unlike cakes of dung, housewives would realise considerable savings in the time they currently spend cleaning soot-stained cooking utensils. Furthermore, the replacement cost of pots is significant for the very poorest families, who own a total of only three or four.

It might be noted here that ways have been suggested of collecting animal urine which is currently largely wasted, and adding it to the gas plant. Since even the small marginal farmers in India have to buy urea and phosphate-nitrogen fertilisers, gobar gas plants would help to reduce the need for such major cash purchases from the city and increase farmer savings.

Critique

Not all of the advantages that have been claimed for gobar gas technology bear up under scrutiny. For instance, consider the gobar gas plant design that has received the most exposure and promotion in India. It consists of the following components:

(1) A trough for mixing up the dung-water slurry and a pipe leading this slurry by gravity to the bottom of the digester well.
(2) A digester well, lined and finished so as to be impervious, constructed to a size and capacity that is designed and specified by a specialist.

(3) A metal dome cover that is set so that its rim is in a masonry collar inside the well. When the well is filled with slurry the dome forms an air-tight enclosure to the well. As gas is generated and exerts pressure the dome moves up and its weight is designed to pressure the gas to the required degree.
(4) The gas is conveyed out by means of a hose that is attached to the top of the dome. For efficient delivery of gas it is best to use it within a ten- to twenty-foot radius of the gas plant since problems of pressure drop, condensation and breakage of pipe increase as the pipe length increases.

It is quite clear that not only are most of the components of the gobar gas plant produced outside the village economy but the skills required to manage, repair and maintain it must be introduced from outside. The labour for construction of the plant can be largely supplied by local people such as the owner himself, his family, local masons and day labourers as long as there is careful technical guidance and supervision from the gobar gas plant specialist. Gobar gas plants require bricks, cement, cast iron dome, piping, etc., which must be acquired from outside the village. Case studies of plants constructed in other regions of India show delays of over one year due to bottlenecks in delivery of these materials. Thus the technology becomes difficult to deliver in the face of scarcity of raw material resources.

Some researchers have questioned the connection between deforestation and the use of vegetable matter for fuel. They note that what many families burn are the stalks from their crops or small bushes that are grown as fencing and for fuel. Tree- and leaf-cutting are carried out mainly for house construction or for the feeding of animals; thus, they argue, deforestation will not be affected by the installation of gobar gas plants.

The argument that savings will result from the adoption of gobar gas can also be criticised. Farmers who do not currently buy their fuel will realise no savings by investing in a gas plant. Furthermore, savings of time and money in the kitchen are not perceived as important by the man, and it is he who makes decisions concerning family investments.

Still another factor, however, frustrates the realisation of the benefits of gobar gas technology. Despite the great interest in the gobar gas plants and their active promotion by the state and central government, they have not received widespread acceptance in the villages. A study of gobar gas plants in Gujarat by the Indian Institute of Management indicated that adoption rates were low and most adopters (76 percent) were larger farmers who owned more than 10 acres. Even the few adopters who had less land were not the really marginal or landless farmers whom the proponents of this technology claim to want to include. This finding is corroborated by more casual observations in Maharashtra. Generally there is widespread curiosity about the technology but few adopters. As in Gujarat the majority of gobar gas plant owners tend to be the more affluent farmers. The Gujarat study further noted that the rate of adoption of the gobar gas plants had been decreasing particularly in the low status groups and there was fear that if this trend persisted only the well-to-do in each village would benefit from the technology.

If the majority of villagers do not use the gobar gas plant some of the social benefits that are claimed to accrue from it and for which the technology is being actively propagated—such as reduced deforestation and generally improved sanitation and health—cannot in fact be actualised. If the gobar gas technology is to improve rural conditions in any dramatic way a more widespread adoption which benefits the small and marginal as well as the affluent farmers is essential at the village level.

A cost-benefits study on the economics of village-level gobar gas plants done at the Gokhale Institute indicates that under existing technology, a gobar gas plant of a size requiring three or four cattle to provide the necessary dung is economically profitable but any plant smaller than that is not. This is partly because the larger capacity gas plants operate more effectively, since it is easier to maintain them in the temperature range of between 25 and 35 degrees Centigrade which is desirable for methane generation. This technical limitation immediately precludes small farmers and landless villagers who generally own only one or two cattle apiece from adopting, unless they co-operate with each other and share a medium-sized gas plant between three or four families or unless larger sized communal plants are built.

Based on the review of the literature on the subject and discussions of the problems of gobar gas adoption with researchers, it appears that although there is substantial room for technical improvements and refinements of various aspects of the plant, they do not constitute the critical bottleneck to successful and more widespread adoption. Gobar gas plants of the type presently available have been constructed and successfully used by individuals over a number of years. A reduction in the price of installing a plant and technical innovation, such as a new plant design that operates efficiently on dung from only one animal or on the human waste of a small family would make adoption of gobar gas plants more attractive to a greater number of families. Even as it stands today, however, investments in gobar gas plants should be more attractive to a greater number of rural, farming families than are currently coming forward to adopt it. In addition, co-operative gas plants could bring the technology to within reach of even larger numbers of small farmers and agricultural labourers. Why then are villagers not adopting gobar gas in significant numbers?

The Village Perspective

In an attempt to gain insight into the factors that were important and contributed to non-adoption of gobar gas plants at the village level, a number of interviews were carried out by the author in 'Sugao' village, a small predominantly peasant farming community in the Deccan region of Maharashtra.

Sugao has been extensively studied in detail since

1937 by various researchers at the Gokhale Institute of Politics and Economics in Poona and by this author. As a result of the power structure, the social hierarchy and relationships, the distribution of wealth (particularly in terms of land holding), the centres of moral leadership, and the opinion makers in the village are identified and well understood. In addition, the author has lived in the village for varying periods of time, spanning more than one and a half years in 1976-77 and as a result, people in Sugao feel at ease and give factual information to him fairly readily. As a result of the long connection with Sugao the overall process of change in the areas of economic activity, social relations, and political awareness has been monitored and studied in detail. This provides a rich contextual background for the study of the specific problem of non-adoption of gobar gas plants.

Many men as well as a few women from various social strata living in the village expressed their views. Interviews were carried out with large landowners who are the accepted leaders and spokesmen for the village, with middle and small farmers, with some high school teachers, and with some of the lower caste day-labourers.

In 1976 it was clear that a number of Sugao farmers, particularly the larger farmers, had heard of gobar gas plants and were aware of the financial subsidy, low-interest loan and technical know-how package that the Khadi and Village Industries Board were offering to adopters. There were, however, no adopters. In 1979 there was more widespread curiosity and knowledge about gobar gas plants but still not a single family had invested in one.

Space Constraints: When larger farmers, the acknowledged leaders and trend-setters in adoption of new things, were queried they displayed a fairly clear awareness of the gas technology. Some had even visited other villages to observe installed plants. They all indicated that they had given some thought to investing in a plant for themselves but all but two of them, who had built new houses on the periphery of the village, discussed the serious space constraint on its construction around their home.

Sugao, like most villages in the Deccan region of Maharashtra, is a nuclear clustered village located in the middle of its agricultural land. Village housing is fairly dense and narrow lanes and alleys give access to the centrally located housing. In this configuration it is rare for a farmer to own and be able to spare the minimum 30 or 40 square feet of land, within a 20 foot radius of the kitchen, required to build the gas plant on. Even in discussions with smaller farmers about the possibility of co-operatively building a gas plant between four or five of them, this problem of land scarcity surfaced. Additionally, in a co-operative situation none of the members would want to give up housing land that they owned individually for a co-operative gas plant because they feared that all the other members would acquire easement rights over this area. For a technology that seems tentative and exploratory, as gobar gas still does to villagers, these farmers were not interested in jeopardising their ownership of even a scrap of individually owned house site land.

This chronic space problem is fairly typical for many areas of Maharashtra. Traditionally in the state village settlements are nucleated and clustered in form and with time result in tightly packed housing on the limited village site. In a clustered village, such as Sugao, the technical development of a fixed-dome gas plant that has no movable parts and can be buried underground, under the floor of adjacent cattle sheds or a room, would possibly make the plant a more attractive investment. Versions of such a design are in use in China and are being developed in India. This 'Janata' model consists of a digester-well covered with a fixed brick masonry dome and an inlet and outlet. Because the dome does not move, less maintenance and care is required in its operation. Despite a few current problems with the rate of generation of gas, the Janata units are cheaper and could be valued more for the superior quality of organic manure they produce.[2]

Another space requirement is for the storage of the digested slurry. In an ideal low maintenance set-up the effluent is led into pits where it dries out to be used as manure at strategic periods in the agricultural cycle. Compost material added to this is converted quickly to a rich organic manure. In a space restricted situation, however, arrangements have to be made to catch the effluent and carry it to compost pits on the periphery of the village which makes for an additional chore in the crowded day of the cultivators.

The gobar gas plants work more efficiently at gas generation if night soil is added to the digester. In order to facilitate this, some type of toilet, primitive though it might be, has to be constructed and hooked up to the plant. Most villagers do not like the idea of a toilet so close to home. They are afraid it will smell as well as require too much maintenance and (most importantly) space and money. All these factors become even more of a problem in a co-operatively owned plant.

Water Constraints: Solving the space problem could certainly make the gobar gas plant more attractive to larger farmers, and perhaps even to smaller farmers thinking of a collectively owned and run plant. There is, however, still another resource constraint that is a factor in non-adoption: the scarcity of water.

Sugao has been fortunate to obtain some twelve years ago a government financed piped water scheme to distribute water to common taps scattered throughout the village. Water is turned on for a couple of hours in the morning and has to be stored for use during the day. The village was not involved in construction of the water scheme; it came as a 'free gift' through political connections. Right from the beginning the scheme did not deliver sufficient water to the furthest end of the village and a new, improved scheme that has been partially constructed floundered when the contractor embezzled the funds. Villagers have become disgruntled and rather than maintaining and making the best of the scheme they

have started to break into the pipe and create unplanned tapping points, which have no bibcocks to stop the flow of water when not in use thus resulting in even more wastage. Altercations every morning at each tap are common.

For the proper operation of the gobar gas plant, cow dung and water in a ratio of 4:5 by volume are mixed into a slurry to be fed into the digester. In the water scarcity situation existing in Sugao it will be a major chore for someone to obtain, every day, the necessary buckets of water to keep the plant going. In a communally owned plant this chore will probably be even more resented. As one village woman exclaimed, "It's a fight to get enough water to drink for everyone! Who is going to wage a battle to get more for this gas-plant?"

Social Factors: The history of co-operative ventures in Sugao has not been encouraging. A foodgrain and cloth co-operative, a jointly owned flour mill, and a weavers' co-operative to obtain credit, raw materials and markets have been started, have functioned sporadically for a couple of years and then have failed, often due to defaults and outright corruption. The failure of co-operative ventures has left participating members saddled with debts and idle equipment. Villagers, with good reason, do not believe in each other's capacity to maintain agreements over long periods of time. Because of this even blood-related families and members of a former joint family are reluctant to consider any joint ventures such a collective gas plant. The history of fuels in the village has also bred mistrust and pitted family groups and castes against each other.

In the scarce resources economy of Sugao individual families are concerned about how their contribution of waste to a community plant would be measured and what share of gas and manure they would get from it. In successful pilot projects of community gas plants these problems have been solved in the following ways: Each family's contribution of waste is weighed and noted each day. Gas is released for set hours every day during meal cooking times and families can use as much they want at this time. This time-rationing system is introduced rather than individual meters because at present with the available technology these meters are very expensive. Perhaps a technical breakthrough here to reduce cost would be useful.

It was reported by those who have worked on such community plants that people are not happy with this distribution of benefits. They think of the gas as the major benefit from the gobar gas plant. The enhanced quality of slurry, which larger contributors of dung get proportionately more of, is not immediately apparent since it is stored in compost heaps and applied at periodic intervals. Thus farmers perceive this system of distribution of gas as inequitable and there is less incentive to collect cow dung from longer distances in the outlying fields. The result is a corresponding reduction in the amount of dung supplied to community plants.

An additional cost and maintenance problem is the piping to each household. As distance between plant and kitchen increases, maintaining the gas pressure becomes a problem. Some families whose houses are further from the plant may at times get less gas than they need for cooking. This will inevitably cause disputes. From past experience, villagers are sceptical that careful accounts of everyone's contributions will be maintained and a fair distribution of the product will be ensured in a co-operative gas plant. Someone has to be designated to keep these records who is trustworthy, literate and able to spare the time. On a volunteer basis such a person is difficult to obtain and paying for the service adds another cost. The smaller plant size servicing fewer families begins to look less attractive.

Dr. David Gosling, who has worked extensively on bio-gas in Sri Lanka, is explaining to a village worker in Christa Illam the operation of a gas burner which uses bio-gas as fuel.

Toilets and User Preferences: If toilets are built and hooked up to a gas plant, whether as individual units, small groups or large community ones, the amount of water each individual uses has to be strictly controlled. Excessive use of water dilutes the slurry in the digester and impedes the process of gas generation. Villagers are not used to squatting over toilets and have to be taught not to foul up the surrounding plinth. If water is unavailable it is a custom at present to use small stones or foliage to clean one's self, and villagers have to be taught not to do this in the new toilets, as these items would just block up the toilets. The whole process of social education has to be done slowly and with regard to people's inhibitions and feelings. Older people will resist the idea of having to wait in line at times to use the toilet facility. Women may not like to give up the few minutes of social time they enjoy when they go to the fields to relieve themselves and linger to chat with other women there. This is one of the few occasions in the day that young women can discreetly escape the watchful eyes of their in-laws or parents. The design and introduction of toilets, if they

are to be used successfully by the villagers, will have to recognise and be sensitive to such social realities.

In other areas of India villagers have resisted the idea of using night soil as manure on their land and resist even the idea of cooking over a gas that is generated from a slurry that contains human excreta. In Sugao, however, none of the many villagers questioned voiced any reservations about this. Someone in fact described how green and good the crops had been in a neighbouring village where such manure had been used.

Villager's Perceptions of Benefits: Although a number of studies are underway or being completed on the cost benefits of such gobar gas plants, the evidence is not conclusive and opinions differ on what benefits accrue in reality. In any case, the decision to adopt or not to adopt a technology, either at the individual villager's or the community level, does not appear to be heavily informed by such criteria. The villager's perceptions of benefits and the values he attaches to them differ from the specialist's. A gas plant meeting the needs for lighting and cooking in a household is not considered a high priority item, especially since the major beneficiaries are women, a group that has little decision making power in the village. However, if the energy from the plant is used to run a flour mill or thresher or to pump water for a tube-well, then it is considered a major benefit and improvement.

Similarly, if the villager has enough land and grows plants and bushes so that he buys little wood for fuel, then he does not value very highly the fact that a gobar gas plant provides him with fuel for cooking. Another case in differing perceptions is that of the usefulness of threshing machines. If a farmer owns bullocks he will continue to thresh his grain in the traditional way under the feet of the bullocks rather than take the crop to the mechanical thresher for whose use he has to pay.

Presently most of the energy needs of the villagers are in fact being met in one way or another. A gobar gas plant is perceived as providing facilities and improvements that are more qualitative in nature. Besides, it appears to be more useful to women than men and therefore is discounted when men make decisions about investments.

In addition if only one element of improvement technology, such as gobar gas, is introduced into a system that remains essentially the same in organisation and production, the impact is only at the margins. To be fully integrated a more comprehensive, evolutionary transformation of the total structure is necessary. The agent that induces change has to be much more widely based as well as cognizant and responsive to all of the constraints that operate against adoption and assimilation of new ways.

Overcoming Constraints

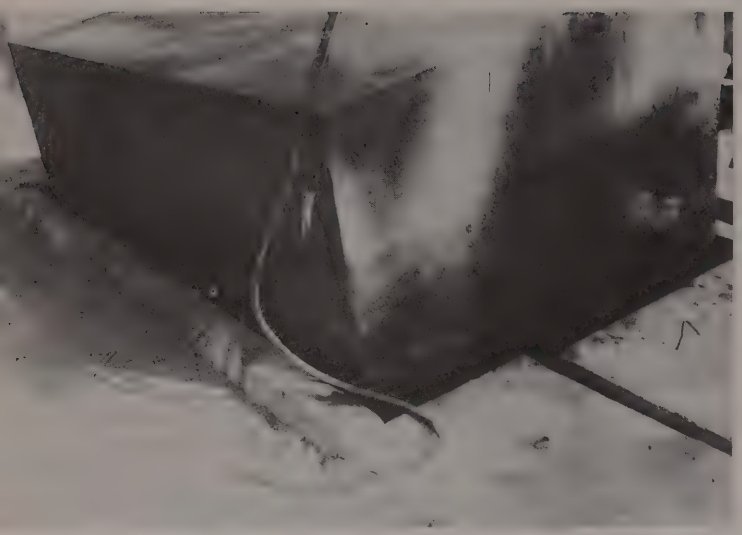
The constraints outlined above are not insurmountable. If there is little space around houses, plants can be installed underground or at the periphery of the village near the fields that villagers currently use for relieving themselves. If distance prevents the piping of gas to households, the gas can be used for some community purpose such as street lightings or a small scale industry. Installation of gobar gas plants can be delayed until bottlenecks are overcome and an adequate water supply is assured. Villagers can change their toilet habits. But if villagers see no clear advantages to this technology, they are unlikely to invest in individual plants. If, in addition, they are suspicious of co-operative ventures, it will be a long time before gobar gas technology appears in Sugao.

It would seem that the initiative for installing a gobar gas facility must come from some outside agency. Such an agency could construct larger-sized communal facilities on the outskirts of the village. Once a system of toilets, a gas plant, and soak pits were constructed, they could be supervised by salaried individuals who would insure that the system was kept clean and operational.

Nevertheless, the organisational solution of hiring people to maintain such a facility becomes dubious when assessed in terms of social goals. Starting with Mahatma Gandhi's "bhangi mukti" programmes to free the scavenger castes from the socially untouchability their work brought upon them, the effort in development planning has been to eradicate caste distinctions and discriminations, especially those of untouchability. The technical, organisational solution suggested for community gas plants would in fact create a new, scavenger class, albeit a salaried one. Besides this basically moral question is an economic one: whether small or medium gas plants could generate enough income to eventually pay for the services of such individuals and whether the plants would eventually pay for their maintenance.

When questioned about the possibility of introducing gobar gas units to Sugao one of the respected village leaders, who was noted for his foresight and concern about village affairs, insisted upon digressing from this topic. He proceeded to talk about and finally to show a new device introduced into Sugao's very rudimentary waste, drainage and sanitation system. Three of the large farm families in Sugao whose houses were located on the edge of the village had bought special toilet pans and begun construction of day pit toilets that were developed by a Gandhian organisation as valuable devices for collecting and converting human waste to fertiliser. These toilets are very simple in design and relatively inexpensive. They work on the premise that night soil when covered and left to decompose for some time converts to valuable manure. Despite their simplicity and ease of construction the three toilets that were started in Sugao were incomplete because they needed a small amount of cement to form the channel joining the toilet pans to the soil pit. Cement being in short supply had been unavailable to these Sugao families for six months. The larger quantity of cement needed for a gobar gas plant would have constituted an even greater constraint.

Referring to these pit toilets and to his observation of trench toilets provided at centres of large religious festivals which he had attended, the village leader sug-



The picture above shows a bio-gas digester in the village of Christa Illam in Sri Lanka. The gas produced from the bio-mass (in this case from manure) is collected under the large metal cube. The weight of the cube provides the gas with pressure, which is then led to the kitchen by the rubber tube, where it will be used for cooking.

gested an approach to improving the physical plant and living conditions in Sugao. He suggested that funds be raised to hire a few people to dig pit trench toilets in the existing fields where people presently relieve themselves. Some low, temporary partitions, made of cheap mats, could be installed for privacy and a few paving slabs could be placed as footpads to squat on. People could be taught to use the trench toilets and to cover over the excrement with the heaped up soil from the trench cutting. When full, the trenches would be covered by soil for a few months, new trenches would be dug, the partitions moved, and the fertiliser created could either be sold or applied to commonly owned village grazing lands that are so barren today.

One more proposal that he made was that drainage and paving material could be bought and supplied to the village. The villagers would organise themselves in groups to slope and level the streets and alleys around their houses, dig out the drainage ditches and pave them to facilitate the removal of waste water from the village itself. The present sloping of streets and alleys has evolved over many centuries and functions reasonably well. The hard surfacing, however, would considerably improve the functioning of the system.

With these two very simple technological introductions and a change in the social practices, the general cleanliness and living conditions of Sugao could be enhanced. The improvements would not achieve everything that widespread use of gobar gas could, but some gains would be made and the village would learn from successful completion of an immediately useful co-operative effort. This might lead to increased trust and a propensity to venture upon innovations and changes requiring more complex reorganisations of traditional relationships. These examples of technologies that appeared to be implementable to the village leader highlight the fact that to be considered 'appropriate' a technology has to not only be responsive to resources, needs and goals but must fit into the social organisation and context that prevails.

That groups in Sugao do evolve and learn from social group action was illustrated by the neo-Buddhists (former untouchable Mahars) of Sugao, who traditionally did the scavenging work in the village. In 1979, they were in the final stages of completing a collective lift irrigation scheme to irrigate their small land holdings. Once it was started successfully their leaders would be ready to explore the possibility of communal gobar gas plants. They were discussing raising cattle co-operatively with fixed stall feeding and using the waste to fuel the plant. They wanted to establish some small scale industry that would use the gobar gas generated and provide employment for a few neo-Buddhists.

Conclusions

In response to questions about the possibilities for communal gobar gas plants, a village leader responds with a suggestion for social reorganisation around even simpler and more basic technologies of pit toilets and improved surface drainage of village lanes. This is the voice of experience. It is sensitive to the limited power village leaders or outside agents of change have to affect the manner in which village people relate with each other and what they are willing to invest their time and money in. It speaks of the necessity of incremental steps and incremental gains of 'setting the stage' for future adoptions of technology requiring more complex social reorganisation. It illustrates the importance of striking a balance between choosing and modifying a technology so that it fits into the social organisation of village life in India and in the process of introducing the new technology attempting to incrementally modify the existing social relationships.

The willingness of Sugao's neo-Buddhists to take risks to co-operate has been increased by their success in organising a collective lift irrigation scheme. A similar growth of social confidence could equally occur in the village as a whole around other successful actions that would benefit the whole community; for instance, the scheme suggested by the Sugao leader for improving waste disposal. The evolution of social organisational capacity can result from introducing more basic and simple technology that delivers some benefits and creates a social environment receptive to reorganising in ways that are essential for the widespread adoption and assimilation of other further reaching technology, such as gobar gas, that may be more transforming of society in the long run.

Social readiness to absorb and assimilate a new technology is an important criterion for assessing whether a technology is an 'appropriate' one for any particular context. It must be given equal importance when considering the possible application of a particular technology in a specific context. A technology is only fully 'appropriate' when there exists a fit between it and the

organisational capability to receive it in the social system in which it is introduced. In addition to technical efficiency it must also be judged from this perspective and from the point of view of its ability to shape and change the social environment in ways that will facilitate incremental steps toward transforming rural life.

1. Gobar gas is generated when organic matter such as animal, human and plant waste is mixed with a given proportion of water (4:5 ratio) to form a slurry. This is fed into an enclosed, impervious container called a digester and allowed to decompose. Methane gas, along with carbon dioxide, (in a proportion of 55 percent to 45 percent with traces of hydrogen sulphide) is generated by anaerobic bacterial action. This gas is collected in a dome placed over the digester and when it reaches the necessary pressure it can be released and burned to provide energy for a variety of uses. An overview of the evolution of the technology is given in S. K. Subramanian, "Bio Gas Systems in Asia," Management Development Institute, New Delhi, 1977.
2. In his paper, "Energy Alternatives for Irrigation Pumping: Some Results for Small Farms in North Bilbar," Ramesh Bhatia states that the gobar gas research centre at Ajitmal in Etawah district of Uttar Pradesh has developed a gobar gas plant based on the Chinese design. There were 45 such plants in operation in the area in 1978. Their advantages are that the capital cost is 40 percent lower than the conventional plants, local masons can do the work of constructing it, and maintenance costs are reduced since the steel dome which required periodic painting is eliminated. These plants can be constructed under the ground beneath a cowshed or other area near the kitchen. Scientifically measured comparative techno-economic parameters of the two types of plants are not yet available. Also some problems of choking up of the plant due to incorrect mixing and over-adding of slurry have been encountered.

III
The Greening of the Himalayas

United Nations

A group of porters in the mountains of Nepal.

B. N. Juyal

The Chipko movement held its fifth anniversary on March 23, 1978. The on-going Forest Rights movement in the Himalayan hill region was actually born on May 30, 1969. The movement gained its new name when it led to direct confrontation with the State Government (of Uttar Pradesh) and came to use the dramatic hug-the-tree action as a technique of non-violent resistance, that is, a *Satyagrahi* imposing himself between the feller's axe and the doomed tree. This technique was first used on March 23, 1973, and since then the movement has come to be known after the technique. In the piece we refer to it by this more popular name.

A press which is chronically starved for rural change and protest news (and that, too, from the peripheral zones, mainly because its feeder channels close off at the regional urban centres) naturally highlighted the Chipko. With the exception perhaps of the Naxalite movement at the beginning of the eventful decade 1967–77, there is no rural protest movement which received so much coverage in the national press, including quite a few leading editorial comments with the added difference that the press has been all-around sympathetic to this movement. Various governmental leaders, including the Prime Minister, have upheld the objectives and method of the movement. It was expected that the Janata Party which is in power in the State as well, with its commitment to the Gandhian path of development and to the *people* (this is what they profess) would view the movement in a

different perspective and the conflict would be resolved easily. But far from it; the State government has adopted a more stubborn posture than the previous one.

Through the clatter-patter on the environmental issue evoked by the international campaign, the Chipko is most probably the only popular movement for environmental protection. It has a strong peasant base with an active student front and is entirely run on local initiative. It has deservingly caught some attention in the international developmental circles as well. The movement bases itself on the Gandhian model of creative conflict, something akin to which is being discussed among certain developmental groups as well. Thus the experiences of the movement will be relevant to the developmental field. However, no formal evaluation is intended here.

The movement did not start off with a format. It has evolved during the years through a process of identification of the problems: from manifestations of environmental deterioration in the region to communication with the wider scientific research field. When the movement was launched in January 1969, it aimed at peasant mobilisation on two main issues: (1) change in the agency system for exploitation of the forest resources, of which the forest contractors are the main feature, and its replacement by what is known as the Maharashtra-Gujarat pattern, i.e. recognition of forest-labour co-operatives as direct agencies for this purpose; (2) greater access of the local population to the forest resources for their basic needs like fuel, fodder and building materials.

It is of great symbolic importance that the movement was launched at a place and on the date when, in the wake of a peasant rebellion against trampling of the traditional forest rights by the native rulers of Tehri state, half a dozen persons had been killed in a swoop down by police on the peasant assembly. The Charter of Demands adopted on this day, which began to be celebrated as 'Van Diwas' (Forest Rights Day), was used for education of the people. Simultaneously some efforts were also made to organise forest-labour co-operatives which were stonewalled by the forest department of the government.

Then in the following years, evidence started piling up that the Himalayas, celebrated as the epitome of 'steadfastness' in the classics and folklore, were crumbling. There was a train of flash-floods and landslides erasing human settlements, killing animals, destroying agricultural fields carved out of the mountain slopes with great human endeavour. Even then the first demonstration of Chipko (in March 1973) was against rank discrimination in allotment of a particular species of tree against a local co-operative manufacturing agro-implements, in favour of a big sports goods firm. But the major campaign the next year, launched by the peasant women of Raini, was clearly against environmental deterioration caused by forest felling.

Thus, micro-level economic issues came to be viewed from the larger ecological-environmental perspective. With this the movement has also come up against a tangle, a contradiction which any field-based environmental movement is bound to face. This is about striking the correct relationship between the economic and environmental demands on any regional (whatever the size) system.

To add a little historical perspective to the raging forest question, the process of incorporation of the virgin forests under government control started in the closing years of the nineteenth century. Along with incorporation, the colonial rulers introduced monetization to suit their commercial interest. In the process they gradually changed the character of the forests, replacing the mixed, broad-leaf species-dominated pattern by a pattern of mono-cropped coniferous trees. The central Himalayan region fell an easy prey because of its proximity to the central Indian plains. In spite of the fact that the British forest officers left behind some fine notes on forest conservation, the accessible forests under their administration were destroyed much beyond the optimal limits defined by them. They have themselves admitted that the inner zone forest ecology had been ruined by the close of the Second World War.

Another basic feature of the colonial forest policy was the agency system for exploitation of forest wealth. As the rural landlords the colonial administrators promoted a small coterie of forest contractors who held large forest leases and proved to be the best collaborators in the Empire. This new elite, with the change of times, switched roles to become representative leaders.

Nothing, virtually nothing, has changed from the colonial pattern of forest administration, except that exploitation has increased manifoldly. The expansion of infrastructure carried the process deep into the peripheral forest zones in the upper reaches of the Himalayas, the ecology of which was much more delicate. The forest settlement made in 1922 which fixed the limits of forest produce for the local population still remains in force. This, in spite of the phenomenal demographic expansion and the accepted fact that the so-called civil forests near the settlements, handed over to the Land Revenue Department for administration, have been totally denuded. (Though the civil forests occupy nearly half of the total forested area, they yield just about 8 percent of the total forest income.)

The new accent on making the forest yield more and more in order to have forests as productive as the advanced forestry in other countries actually meant extracting more and more from the already over-worked forests. In the name of inviting the capital to go to backward regions, extensive schemes of monocropping were launched to feed private industry and parcel out captive forests to them, thereby violating all norms of scientific forestry. The sheer maintenance expenditure on forest bureaucracy has been mounting; some records show that the British government spent about 75 percent of the forest income on conservation and about 2 percent on administration. Compare these with the latest figures about proportion of income spent on conservation: 1974–75, 19.44 percent; 1975–76, 11.74 percent; and 1976–77, 9.67 percent.

Forest predominates in the land use pattern of the region, using about 60 percent of the land area, providing the traditional agricultural frontier of local peasantry. In the region only about 15 percent of the land is available for cultivation, which supports as much as 65 percent of the population. Even under the most precarious conditions of rainfed upland agriculture the per capita land holding per cultivator works out to a mere 0.5 acre, and the annual income per cultivating household to Rs. 1086.

Furthermore, soon after independence the ruling elite, looking for new victories, launched a gigantic scheme for reclamation of the virgin lands in the *tarai* tract at the Himalaya foothills, which the scientists now pronounce as equal to committing ecocide. But the reclaimed land was not allotted to the depressed hill peasants or the peasant labourers who worked on the reclamation project. Instead, it was parcelled out among sugar mill owners, military officers, political leaders and the like, promoting a chain of *Kulak* farms. This laid the foundation of an exploitative system which, 20 years after, has led to the worst carnage (on 13 April this year). Nearly 200 farm labourers working on a public-sector farm were killed while agitating for the minimum wage fixed by the government itself.

Contrary to the aims of the National Forest Policy Resolution, 1952, which laid stress on welfare of the forest peasants as the guiding principle in forest management, and for this purpose enjoined the State (under whose domain forestry falls) to actively promote forest labour co-operatives, the contractor-system has further spread its tentacles. Forest operations give enormous scope for generating black market money which becomes handy for political manipulation. The collusion among politicians, forest contractors and forest bureaucracy, within the framework of State monopoly, resulted in brutal exploitation of the forests and the forest labour through pervasive corruption. According to one estimate the forest contractors reap super profits at the rate of 100–150 percent per season, while the gross labour wage earnings hardly come to Rs. 100 per month. No wonder the majority of the forest labour is under bondage. Their active life span is drastically reduced by hard manual work under most arduous conditions at high altitudes. Though scores of workers are killed every year in accidents, no workmen's security and welfare laws were extended to them. During the emergency-legitimisation drive these benefits were extended to them, though no agency was created to reinforce them in far-flung forest areas. However, the State government is reported to have suspended operation of these laws with regard to the forest labour. In short, the law of the jungle prevails in the sordid business of forest operations. Various departmental inquiries even prove that the contractors violate the regulations, thus nullifying the forest department's calculations about controlled removal of forest produce.

Thus a pattern during colonial rule and still holding sway even after three decades of Socialist (?) planning has destroyed not only the forests and the environmental quality, but also the economic pattern and social fabric of the local peasant communities. The already precarious peasant economy was further depressed by the agricultural frontier being blocked by geographical conditions, the government reserved forests, land reclamation schemes and the phenomenal rise in local population. This set in motion a long line of migration; along with the forests, water and soil, the human resources were also drained out of the regional society. These forces brought into being an economic pattern which is most eloquently called 'money-order economy', i.e., the family subsisting in the mountain village on remittance from the earning male members working in different parts of the country.

Under such conditions a process of alienation was bound to affect the relationship of the peasants with the forests. In the initial phases they had openly resented and at places even rebelled against the penetration of the government forests right up to their hearths, but through suppression this resentment seeped down and became hidden hostility and apathy. The peasants were left with no option other than bribing the forest bureaucracy, or hoodwinking them, to meet their daily needs of fuel, fodder, cattle grazing, and so on.

Still, the State government holds that there is nothing wrong with its forest policy. However much the leadership may criticize the colonial rulers for exploitation of the country, when it comes to any structural reform in the organisational pattern left behind by the colonial rulers the present leadership starts upholding it to the core. The British forest officials introduced the procedure of drawing up ten-years' working plans for each forest sector, so as to extract a sustained yield from them. This prosaically followed procedure is held sacrosanct, and is used as a scientifically proven argument against any change in forest policy. It does not matter that in the areas where, according to the working plans, there should have been a thick forest cover entire ranges look absolutely clean-shaven. Thus the ritual becomes more important than the worship. On the other hand, for years the State agencies have been dishing out land-use statistics which have proved to be widely erroneous. A recent investigation has revealed that the actual forested area is about 35–40 percent less than what has been reported in official statistics, and more than half the forests are on such steep slopes that the process of regeneration will be many, many times slower than the generalised norms accepted for forest planning. And what is most amazing is the denial of the fact that the parameters have drastically changed in between the hundred years when British foresters had propounded their plans. Then the Himalayan foothills were covered with thick, virgin, mixed forests, only the fringe of which was touched by sparsely populated and scattered rural settlements. Since then, ever-increasing population of humans and cattle and reckless commercial exploitation of the forests have completely changed the situation. It will be the most unscientific attitude to say that those planning techniques are still valid.

This is the perspective of Chipko. The movement

has raised all these issues. The over-riding issue is to create a harmonious relationship between humanity and the environment and eliminate those forces which despoil this relationship. In the initial years, as long as the emphasis was on forest labour co-operatives and amelioration in the conditions of the casual (which all of them are) labour employed by the contractors, it did not receive much attention outside the region. In the following years the discrimination against the small co-operative units (manufacturing turpentine, agro-implements) in allocation of raw materials became the main issue of struggle against a myopic state policy. Still, the movement did not receive much notice. However, the movement enlarged its popular base and started getting much larger, more sympathetic audiences when around 1973–74 the issue of environmental deterioration endangering the peasant settlements came to the fore. By this time the environmental issue also gained popularity in the intellectual circles.

The scientists started having a closer look at the facts. The prognosis was that the entire Himalayan river system, with its gigantic irrigation and power structures, is endangered by deterioration in the catchment areas, caused by deforestation. Furthermore, it has been pointed out that the rate at which depletion of the snow fields and siltation of water channels is taking place may turn the entire north Indian plains into a dust bowl within a hundred years. Chipko's most significant achievement is that the long-range macro-level scientific projections have been fused with the existential experiences of the mountain peasants. How the unlettered peasants relate their problems to the macro-context is a tribute to the educational techniques used by the movement.

The prominence gained by the ecological issue has, however, created some difference of opinion among the leadership of the movement. The Chir-pine which dominates the forests above about 5,000 feet provides the main source of timber and resin, and thus seasonal employment to the local peasants. The demand by one section of the movement for a total halt to Chir-pine felling and resin tapping, at least for some years to come, has caused some connected with the economic organisations promoted by the movement itself (e.g., resin-based turpentine units and the labour co-operatives) to drag their feet. No doubt some labour co-operatives have supported this demand, even at the cost of loss of employment. Also, the petty contractors from the area who subcontracted work from the big outside contractors, and who at one time supported the movement in the hope that the field would be left open to them, have started working actively against the movement. So have the people's representatives (i.e., legislators, and other political leaders) who are apprehensive that any moratorium on the forest felling may dry up sources of easy money.

The government leaders in the State seem to be actively helping this regional elite of petty contractors, making use or misuse of the demand made by the movement in a different context: that the forest should be auctioned in small lots so that forest labour co-operatives can afford to bid for them, and manage their affairs easily. The "small is beautiful" slogan provides easy ideological crutches to this policy in which the question of exploitation is reduced to big versus small-scale exploitation. In fact, it has gone to the extent of suspending the minimum wage and other labour laws for the benefit of these contractors.

One of the major implications of this policy is that a conflict has been generated within the local communities. In the early phases the Chipko won easy victories because total community mobilization was possible against outside contractors (i.e., from outside the geographic-ethnic region). But in the later phase, where the local contractors were involved, they did succeed, to some extent at least, in causing a division in the local communities.

The Chipko demonstrated how the motive force of a movement can be harnessed for organising people for economic activities. However, it has also shown how these activities may foster certain interests that conflict with the larger aims of the movement.

The leadership of the movement has come from local Sarvodaya workers. The forest movement comes close on the heels of a rather long-drawn popular temperance movement for pressuring the government to enforce total prohibition in the region. The main issue was that the State government by licensing a number of new liquor shops every year was promoting the drink habit among a poverty afflicted population. The women, who bore the main brunt of this consumptive habit of males, had taken a leading part as the base-line formation of the prohibition movement.

The peasant women who carry the onerous burden of gathering fuel, fodder, thatch for roofing, tending the agricultural fields, and hauling up drinking water from mountain springs and brooks, could easily relate their problems to wrong forest policy. In the Chipko movement they started taking the leading part, in some places entirely on their own initiative.

The slogan of student-youth involvement in the struggles of the peasantry has been raised very often, but it is only in Chipko where this aim has been actually achieved. Given the circumscribed peasant base, acquiring some education and venturing out in search of employment has been the only channel of mobility open to successive generations of hill youth. With mounting unemployment in the country and intense competition for proportionately fewer jobs there is a large number of unemployed youth gathering in the region. The demand raised by Chipko that the vast forest resources of the region should be used for its integrated development naturally attracted the educated youth. The Chipko issues were linked with other issues in student protest.

The main role of the students has been on the agitational front of the Chipko. They have acted as the front line troops, resisting auction of the forests held at the administrative centres. However, some of them have turned into more or less full-time Chipko volunteers, organising field study visits and educational campaigns in the remotest villages. In a few cases they have also

started organising and working with forest labour co-operatives. They tend to form a sub-group within the movement who do not fully agree with the hard-core Sarvodaya workers' approach to the whole forest question.

The movement has a very loosely structured leadership pattern. Indeed, the movement comprises various action groups working in different parts of the region. They do not even have one co-ordinating centre. Of late, owing to some differences of priorities, approach and even subjective factors for some, whatever linkages existed among various action groups are tending to become weaker and weaker.

There are some points of differences among the Sarvodaya workers themselves. A substantial issue is the place of Gandhian technique of *individual* Satyagraha in a mass movement. The main argument against it is that while on the one hand it leads to glorification of the *Satyagrahi,* and thus building him into a charismatic leader, on the other this curbs the initiative of the participating masses. This issue has been raised and not discussed further. The other point is about obtaining support (through appeals, etc.) from the national level leaders which, it is argued, amounts to minimising the contribution of the local peasant heroes. The counterpoint is that mobilization of wider public opinion is also needed for the success of the movement. There also seem to be some subjective factors which have led to more serious differences among some key workers. There is some evidence to suggest that the State government leaders are trying to use these differences in their efforts to cope with the movement by giving different treatment to different groups in the process of consultation, and by conceding a demand in one area and not conceding the same demand in another area.

There is another important aspect of the movement, which is how the movement handles its publicity. No other movement has handled it so well. Some of the key workers are themselves regular contributors to the newspapers. In fact, most of the news that appears in the national press is from source materials provided by the workers of the movement. Some activists feel that this has created more sound than substance about the movement and has led to charges that one is trying to corner the glory at the expense of the other. To some extent the press, by giving unequal focus and coverage to different fields and leaders, has created a sense of rivalry between action groups.

The Chipko has won quite a few victories, some easy and some difficult. On the face of it, it was easy where the confrontation was with the State alone, difficult where the local vested interests also joined the State agency, thus raking up opposition at the grass-roots itself. Secondly, it has been easier to score a point when the issue was to stop forest felling to prevent environmental deterioration than when it came to changing the exploitative pattern of utilisation of forest resources. The road ahead looks to be more difficult: it is only now that the forest contractors and their politician-patrons feel threatened. Thus the bigger challenge lies ahead.

The hand that rocks the cradle is also strong enough to pull a cartload of timber in Ahmdabad. Some Indian women have to play many roles in their daily life, including untraditional ones, so that they and their children can go on living unstarved.

Credit: United Nations/J.P. LaFonte

IV

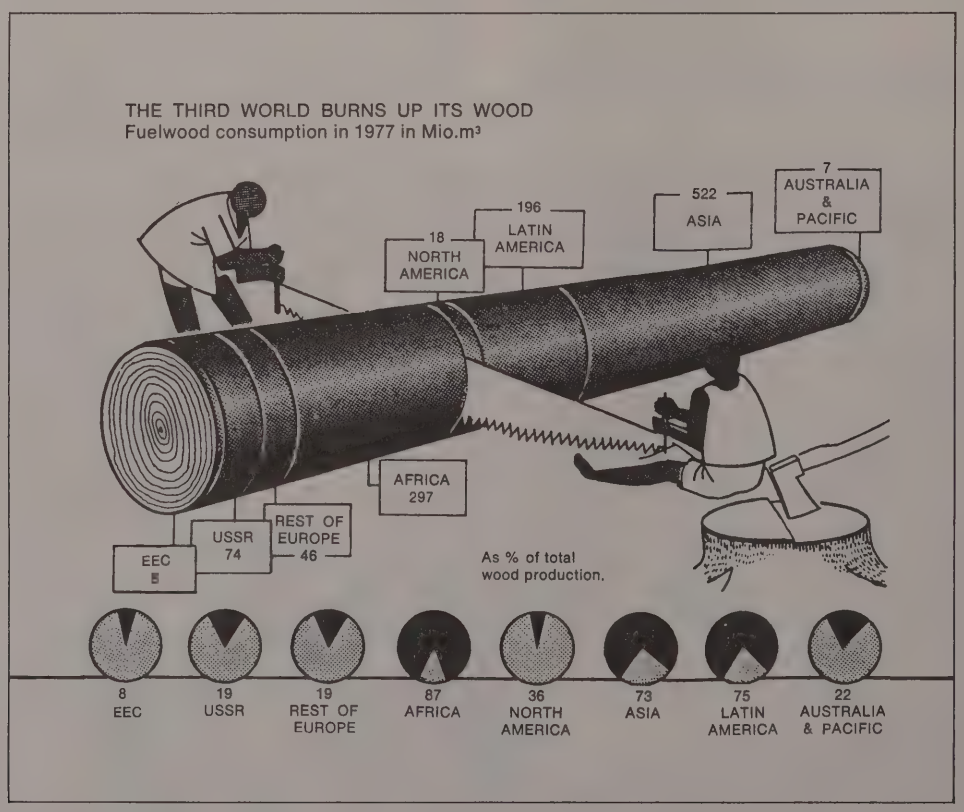
Facts and Figures About Wood as a Fuel

* The most important cause of deforestation is agriculture. Due to lack of land, people are pushed to clear forests and attempt to grow crops in the forest lands. This land, however, often cannot support permanent agriculture and the fertility of the soil can be lost, which can then result in serious erosion.

*Almost half of the world's total wood yield of 2.6 thousand million m^3 is burnt as fuel. It is especially the Third World countries which are forced to use wood as an energy source. The world's forests contribute the equivalent of 400 million tonnes of oil in energy every year representing 6.3 percent of the total world consumption.

* A United Nations Environmental Programme (UNEP) study predicts that if the present rate of forest depletion continues, most of the humid tropical forests of the world will disappear within the next 25 to 30 years.

* Much of the timber produced in the Third World is imported by the industrialised countries. If, for instance, in 1976 the export proceeds of just four tropical timber exporters—Indonesia, Malaysia, the Philippines, and the Ivory Coast—were removed, the Third World would have suffered a net trade deficit of around US$ 2.4 thousand million.



V

Nuclear Power for the Third World?

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THIS POWERFUL, COMPLEX TECHNOLOGY WILL BE LESS THAN A PANACEA TO ENERGY-HUNGRY THIRD WORLD NATIONS CONFOUNDED BY THE RISING PRICE OF OIL.

by Joseph R. Egan and Shem Arungu-Olende

Ever since the beginning of nuclear power in the 1950s, the industrial nations have tempted the developing countries with visions of the atom providing a cheap, abundant, clean, and safe source of power—a stepping-stone to energy self-reliance. More recently, that vision has been tarnished: the applicability and need for nuclear power as an element of economic development are now seriously in question.

Yet even as these uncertainties gain credibility, many of the so-called less-developed countries (LDCs) are experiencing unprecedented opportunities to supplement their dwindling conventional energy supplies with nuclear power—if they have not done so already. Confronted with a barrage of new regulations, a stagnant Western market, and an uncertain political future for nuclear power in their own countries, reactor vendors have turned to the more lucrative Third World market. And two new technical developments greatly expand the potential market for nuclear reactors in the Third World by making them technically feasible for small electrical systems: 1.) a 200-megawatt-electric (MWe) prefabricated pressurized water reactor that can be mass-produced to provide electricity at costs approaching those realized by more common 1,000-MWe models, and 2.) a highly sophisticated sequential-logic control system for electrical transmission systems. Together, these developments could expand the potential market for nuclear reactors in the developing countries by an additional 100 units or more in this century. In so doing they threaten to retard development of the indigenous technological infrastructure that is critically important to LDCs.

Peace Through the Worldwide Atom

Beginning with President Eisenhower's "Atoms for Peace" program in 1953, the United States has consistently promoted and subsidized the export of nuclear technology to the Third World. By 1958, the Atomic Energy Commission had agreements for nuclear trade and cooperation with 43 countries, and research reactors, nuclear fuel, and technical training had been provided to Argentina, Brazil, Taiwan, Iran, Korea, Pakistan, Israel, and Spain. But despite this commitment, nuclear power was introduced slowly in the developing countries. The reason was related to gross electrical capacity.

It is generally accepted engineering practice that no single generating unit should constitute more than 10 to 12 percent of the total capacity of any electrical grid; the idea is to assure system reliability against the failure of any single unit. The standard reactors offered by Western vendors have generally ranged from 600 MWe to 1,300 MWe, with increasing emphasis on the larger sizes as significant economies of scale have been realized. The increasing size of most utility systems throughout the industrialized world has ensured a market for reactors of 1,000 MWe and larger, and most of the nuclear industry has concentrated on building and perfecting these ever-larger units.

But such units have limited usefulness to LDCs. In 1975, there were 41 noncommunist developing countries with total electrical system capacities of less than 1,000 MWe; only nine had capacities greater than 5,000 MWe. The standardized reactors of the 1970s are simply too

large for such systems, and smaller reactors (usually one-of-a-kind modifications of ship or submarine reactors) were too costly and subject to technical uncertainties.

The degree to which a country is willing to sacrifice system reliability for perceived economic or political advantages depends on many factors. Technically, this trade-off depends on the size of the reactor and the sophistication available to prevent the system from breaking down in the event of a loss of generating capacity, and on the importance of uninterrupted power. There are, however, new technologies which enable a power system to maintain integrity despite a loss of 15 to 20 percent of its generating capacity.

With this new technology, a country with a grid as small as 500 MWe and expecting only a 5 percent growth in electric demand per year could technically bring a 200-MWe reactor on line by the year 2000. Indeed, a World Bank study on nuclear power in the developing countries noted that a 200-MWe reactor even without the new relays would expand the LDC market through 1990 by an additional 100 units.

"Small Is Beautiful" in Reactors

A still more important trend in nuclear reactor technology for LDCs is the development—in Britain, West Germany, and France—of small, self-contained units of 100 to 500 MWe. The first such system—a 200-MWe prelicensed, standardized, prefabricated, barge-mounted pressurized water reactor for application to small electrical systems—was announced over a year ago by Great Britain's Rolls Royce, Ltd. (RRL), a new conglomerate consisting of Rolls Royce and Associates, Babcock and Wilcox, U.K. Babcock, Foster Wheeler, Vicars, and most recently Combustion Engineering. Major policy centers paid little attention to the announcement; conventional nuclear reactor technology had already demonstrated significant economies of scale, and the concept of an "appropriate" small reactor had long since been abandoned. The smallest plant financed in over eight years by the U.S. Export-Import Bank is 626 MWe.

But the RRL design is neither a technical nor a financial boondoggle. Complete with containment, full emergency core-cooling systems, and the latest software, the reactor appears to require no major technological advances, and the British conglomerate has the expertise to make the project technically feasible. Moreover, the new group became firmly placed in the civil sector when the government assured substantive product support assistance.

Hardly a year after its announcement, the group is forging ahead with a nine-year development plan, having already engaged in marketing negotiations with China, Australia, Spain, and such unlikely areas as Ghana, the Canary Islands, and the Isle of Man. RRL envisioned exactly such a market and it found the 200-to-300-MWe size a reasonable extrapolation from its military experience. It capitalized on this smaller size by designing an "assembly-line" barge-mounted reactor that would shorten construction time (down to five years or less), avoid many costs associated with site-specific, customer-tailored, large reactor projects, and permit generic licensing, alleviating lengthy licensing delays. In addition, by limiting their production effort to a single location in Britain, RRL hopes to calm many of the labor difficulties that prompted their withdrawal from the stagnant military industry.

Size and the special economies associated with standardization were not the only factors that led RRL to see LDCs as the perfect hosts for the new reactors. RRL knew that developing countries are often willing to make concessions on safety, environmental, and security regulations that would be unacceptable in any Western industrialized country, especially if those concessions implied significant reduction in costs. In West Germany, for example, reactor containment must be 78 inches thick to withstand the possible crash of an aircraft the size of an F4 *Phantom*. In Brazil, however, the Angra nuclear plant being built by West Germany's Kraftwerk Union will have a containment structure only 31 inches thick. The Philippines is constructing a 620-MWe Westinghouse reactor on a site that may well be one of the most seismically and volcanically active spots in the nation—a site that would never be allowed in the U.S. (see following article).

Costs of the RRL design remain uncertain. Estimates as of March 1979 (for a nominal 200-MWe reactor in standard configuration, complete with plant, generating equipment, barge, fuel-handling equipment, site work and preparation, technological support and procurement, and transportation) range from £975 per kilowatt-electric (KWe) using 10 percent interest rates to £1,120/KWe using 15 percent interest rates. These figures translate to a total cost of about $2,400/KWe.

Is this cost high relative to the large units? Perhaps not. In the U.S., 1,100-MWe plants now in the early planning stages are anticipated to cost from $1,600 to $2,000/KWe. An attractive bonus has been added by RRL for potential customers: the company will furnish, free of charge, a kerosene-burning generator of equal capacity on the site until the prefabricated reactor arrives, ensuring immediate 200-MWe capability. The customer must pay only for the fuel.

RRL hopes to be ready for mass production, barring licensing difficulties for a demonstration plant in Britain, in nine to ten years. If those difficulties materialize, they will probably come from the Nuclear Installation Inspectorate (NII), the safety authority for British civil nuclear projects. The problem is that small reactors, like their submarine counterparts, are notorious for the high radiation exposure of plant personnel. (The total annual man-rem dose for the RRL demonstration project could be as high as 1,300, requiring several times the labor needed to operate and maintain a comparable plant in the U.S. or resulting in significant overexposure of workers.) If NII forces the issue, the company may be prompted to locate its first prototype plant in a developing country. Indeed, it is already investigating this possibility.

A research reactor in the Philippines. *United Nations*

Competition for RRL in the small reactor business is already in sight. The French firm Alsthom-Atlantique has a 125-MWe demonstration plant at the Cadarache Nuclear Laboratory, and the German firm Interatom is planning to produce a 60-MWe reactor based on the reactor in the nuclear-powered ship *Otto Hahn*. Most recently, the Kraftwerk Union organization has announced plans for a barge-mounted 200-MWe reactor, a novel and unproven combination of existing reactor technology, for sale to developing countries.

But the most important supplier of small reactor technology to the Third World may turn out to be from the East, not the West. It was in 1970 that the Soviet Union contracted with Finland for the sale of Loviisa 1, a 440-MWe reactor better known as the VVER-440. The total cost was estimated by the Central Intelligence Agency at 500 million marks, or roughly $250 million ($570/KWE) in 1970 dollars. The Finns obtained financing to build Loviisa 1 from the Soviets at 2.5 percent interest over 20 years, an arrangement vastly superior to any available on the Western market. Of the total sale, subcontracts worth 37 million marks were re-

turned to Finnish firms, particularly for the development of quality-control items, for which the Soviets have traditionally lagged behind Western industrialized countries.

Today, the Finns are solidifying a partnership with the Soviet Union to develop the VVER-440 for export. Already the reactor is being deployed in the Eastern Bloc countries on a wide scale, and the Finns are assisting the U.S.S.R. in the development of nuclear power programs in Libya and Iraq. Soviet intentions to export the reactor to the West have been openly acknowledged. Already the U.S.S.R. has allegedly engaged in negotiations with Nigeria for the sale of a VVER-440, a sale that would have important political implications throughout Africa.

The VVER-440 contract calls for uranium and reprocessing services to come from the Soviet Union, purchased with loans at 2 percent interest and at enrichment prices that are 5 to 15 percent below published U.S. prices. Spent fuel is to be shipped back to the U.S.S.R.

These attractive financial terms and fuel arrangements appeal to many nations interested in diversifying their reactor and fuel supply sources; hence, the U.S.S.R. is gaining a competitive edge in both reactor and enrichment markets.

Over-optimism for the Atom?

What is the appeal of nuclear power to an LDC, and why are developing countries willing to make sacrifices to obtain a reactor when most of the industrialized countries are having trouble keeping their own nuclear industries afloat?

In answering that question, officials invariably emphasize economic issues. Many LDCs depend almost wholly on imported energy resources, and they see nuclear power as essential to diversifying their energy supplies. They perceive their own national energy needs and the dangers implicit in heavy reliance on tenuous fuel supplies as overriding their concerns for nuclear safety and environmental problems, which they believe will soon be resolved. Some countries are now using these arguments to rationalize irreversible commitments that do not seem as valid as they once did. Electricity and energy demand projections in the developing countries have consistently been too high, making the need for new generating units appear greater than it actually is; estimates of the International Atomic Energy Agency (IAEA) have historically been high by a factor of two or more. These errors can be attributed primarily to the assumption that large energy growth will be synonymous with rapid economic growth in the LDCs (but much of the LDCs' *economic* growth is accomplished with labor and other substitutions for energy), and to the fact that many small, unmetered customers have not been accounted for.

Other, less obvious reasons for the appeal of nuclear power may be equally or more compelling. The fact that nuclear power is becoming less attractive in the industrialized countries means that the nuclear industry can survive only by aggressive marketing in the developing countries, which are often faced with "offers they can't refuse."

Another reason for the current optimism over nuclear power in the LDCs stems from the assumption by many leaders that LDCs should grow in the image of the advanced industrial societies, which followed practices that implicitly assumed, for valid historical reasons, the availability of cheap energy. This development strategy led to an emphasis on capital- and energy-intensive heavy industry, requiring the creation of electric generating facilities. Until recently, essentially all World Bank loans were restricted to electricity production and distribution systems, as were most projects supported by the Agency for International Development before the early 1970s. An overwhelming fraction of all assistance to the LDCs in energy still goes to the electric sector. Development agencies and banks have thus played an important role in legitimizing nuclear energy development through their lopsided financial support.

One can also hypothesize that nuclear technology has been appealing to LDCs because of the special prestige, important to politicians both internally and externally, that seems to accrue to nations possessing high-level technology. Technological inferiority, real or assumed, can be too hastily equated with political inferiority.

Military issues may also be a critical factor, largely unspoken. Nigeria's recent interest in nuclear power, for example, has been cited as a response to South Africa's apparent proximity to a nuclear weapons capability. Pakistan's former President Zulfiqar Ali Bhutto purportedly admitted that his motivation in buying a French reprocessing facility had been to give Pakistan a nuclear weapons capability, presumably to match that of India. Other confrontations that may have led to the adoption of nuclear power include those of Egypt and Israel, Korea and Japan, Taiwan and China, and Brazil and Argentina.

Both the cost and reliability of nuclear power in the LDCs have been misjudged. During the 1960s and early 1970s, the IAEA used 4 percent inflation rates in economic assessments of nuclear power when inflation rates in many LDCs were topping 100 percent. Though nuclear reactors were achieving only 55 to 65 percent of their rated output in the industrial nations, capacity factors of 70 percent or higher were used in financial studies. Nuclear plant costs and reliability statistics based on Western industrial institutions and operating experience, in any case, proved inapplicable in the LDCs. Delays in receiving new parts from overseas vendors required lengthy shutdowns, skilled manpower had to be imported for routine construction, new institutions to deal with the administrative and quality-control aspects of a nuclear power program had to be created, and long construction times all added their tolls. According to the U.S. Export-Import Bank, not one of its 50-odd nuclear export projects in 16 foreign countries has been completed on schedule.

The safety of nuclear reactors as operated in the

General view of the control panel of the Armenian Atomic Station, Armenian SSR, U.S.S.R. "What is the appeal of nuclear power to an LDC, and why are developing countries willing to make sacrifices to obtain a reactor when most of the industrialized countries are having trouble keeping their own nuclear industries afloat?"

Credit: United Nations/TASS

Third World deserves a great deal more attention than most of the LDCs and their supplier nations have given it. Each nation operating nuclear power plants has a legal, social, and moral responsibility to safeguard the safety and health of its citizens, for which there are currently *no* internationally agreed-upon safety and radiation protection guidelines. Monitoring, regulating, and enforcing such standards would pose intricate problems, and it is not clear that utilities in the developing countries, having had little or no input into the reactor design and construction process, would have the technical or institutional capacity to operate reactors on the basis of the standards. Furthermore, in the Third World there is a tendency for each country to want to exercise its sovereign prerogative by making or enforcing its rules independently. Indeed, potential reactor vendors appear to be counting on safety concessions from the Third World as one means of reducing costs. This may provide only a short-term strategy.

As more and more developing countries acquire commercial nuclear reactors, the chances of serious health and safety accidents will increase—more so for systems with lax safety standards. Such accidents would deal nuclear energy development throughout the world a serious blow. The cost of retrofitting and updating safety standards would soar, and public confidence would be weakened. If they are associated with deliberate safety concessions, and if their effects cross national boundaries, reactor accidents could have serious political consequences for the affected nations and perhaps for the supplier nations. A related issue, too little considered, concerns the impact of widespread use of nuclear energy on the distribution and exercise of political power in the Third World. This new energy resource, entrusted to private, local corporations or government agencies will bring increasing power over national economies and will probably exacerbate the uneven distribution of economic power, and with it political power, already a hazard in many Third World societies. Such capital-intensive, centralized economic power could contribute to the disruption of the socio-economic infrastructures of Third World societies—a form of disruption that has recently become all too evident in Iran, for example.

Lastly, the controversial issue of possible proliferation of weapons technology from nuclear power programs will become increasingly significant as present international safeguards, already inadequate and inconsistent, become altogether insufficient to cope with the greatly expanded LDC market. The recent lifting of U.S. trade sanctions against Pakistan, originally imposed because of that nation's intent to proceed with the development of nuclear fuel reprocessing technology, is sure to be seen by many LDCs as further evidence that there are no effective controls over the transfer of nuclear technology; they may well decide to proceed with their own programs before they are outrun by their competition.

Clearly, before coming to hasty conclusions about an attractive new technology, developing countries must take a serious look at the seemingly extraneous problems associated with acquiring, installing, and operating reactors. Such problems have generated only casual interest in much of the Third World, where technology assessment has been considered essentially an issue for the industrialized countries.

Assessing the Economics of Nuclear Power

The question of nuclear power for the LDCs presents special economic assessment problems. Debt, for example, remains a critical issue. Over the past several years, the debt of non-oil-producing developing countries has reached unprecedented levels—over $250 billion in 1977. By the end of 1978, debts of LDCs held by private banks and international lending institutions such as the World Bank and the International Monetary Fund amounted to over $220 billion, and the debt has continued to mount as world oil prices rise. The additional deficits from the import bill were about $43 billion in 1979, and the deficits for 1980 will be still worse—more than $50 billion. Some decision makers in the developed countries have expressed concern over the risk of instability in the banking systems of their countries; they have thus cautioned against further substantial loans.

This situation directly affects the energy options of the developing countries. One result has been reduced economic growth in many LDCs; this factor—together with the nations' uncertain ability to shoulder a further debt burden—may dampen the enthusiasm for nuclear power and perhaps also the enthusiasm of those who sell it. The Soviet alternative of low capital costs and interest rates may then be especially attractive.

Given this pressure resulting from debt and the growing deficits from oil imports, is nuclear power a sensible alternative for LDCs? True, energy from the atom can replace some of that obtained from oil, especially as a source of electricity. But a harder look suggests that the nuclear option may not solve the problems of LDCs; indeed, a shift to the nuclear option may in some cases accentuate their dilemma. Nuclear fuel will invariably be imported. Nuclear units are capital-intensive, and most, if not all, equipment will be imported. In addition, most technical experts, at least in the initial stages of any nuclear project, will be foreign, hired at international market wages and paid in foreign exchange.

Recent studies indicate that commercial nuclear reactors will require at least one chemical cleaning and decontamination over their 30 to 40 year lifetimes to reduce workers' radiation exposure to safe levels. Preliminary estimates of this cost range from $25 million to $45 million for a 1,000-MWe reactor. Estimates for decontaminating a damaged 1,000-MWe reactor after a major accident range from $100 million to $400 million, including replacement power costs. The structure and costs of an insurance program for nuclear plants are largely unclear: how should the insurance be financed and to what extent should governments share liability?

For these and other reasons, assessing nuclear power costs is indeed complex; there are no agreed-upon criteria, and estimates vary widely. Regulatory costs and government subsidies are hard to translate from one nation to another, and there is no clear indication of how these may vary over time. And two future costs remain unresolved—that of permanent disposal of high- and low-level nuclear waste, and of decommissioning obsolete reactors (estimated to be from $50 million to $100 million for a 1,000-MWe plant).

When all the costs of acquiring, operating, and maintaining a nuclear power program are realistically computed (including security, administration, and regulatory costs), the nuclear picture—at least for the immediate future—may be less attractive than many LDCs assumed. More than ever, decision makers in the developing countries need detailed analyses that include hidden costs and more thorough examination of the assumptions on which these costs are based. Only then will decision makers have credible information from which to make their choices.

The new, small reactors now marketed by Rolls Royce and others promise the cost advantages of a "turnkey" construction system. But such systems must pose a dilemma to many developing countries, for a growing number are ideologically opposed to turnkey arrangements in general. For some, the desire for a nuclear reactor will be strong enough to overcome the misgivings, while others will forego the apparent economic advantages of the turnkey reactor because of their desire to participate in the design and development of the technologies on which they depend.

The current level of debt and the recent sharp increases in oil prices have together stimulated many Third World nations to examine anew their energy development programs, and many are giving increasing emphases to energy conservation and rational energy utilization. This should reduce the tendency, prevalent in the past, to overbuild installed generating capacity, and it should also reduce pressures to add new plants, including nuclear units. Furthermore, many plans for future energy development now put a premium on use in rural areas, further reducing the pressure for large-scale, centralized energy systems and capitalizing instead on the LDCs' vast labor resources; unemployment exceeds 20 percent in many countries.

Accelerating Toward Armageddon?

Despite all these conditions, a growing number of LDCs, whose representatives are convinced that nuclear power is a necessary element of their energy programs in the next few decades, are struggling to finance and secure this technology. They are encouraged by the new developments in small reactor technology that are being aggressively promoted by both Western and Eastern interests. Yet a host of serious difficulties associated with nuclear power in the developing world are yet to be resolved. It is impossible to say with certainty that nuclear power will result in net benefits—economic, social, and political variables included—to the LDCs who embrace it. Indeed, many development experts now believe that nuclear power ignores the very problems that are most critical to participatory and sustained development. It might, in fact, diminish resources available to achieve this end.

Despite such growing evidence, efforts to halt or slow the pace of nuclear power growth in the Third World are met with increasing resistance by LDC government officials. This is partly because these efforts are often undertaken in ways that are politically condescending; partly because efforts to control the spread of nuclear technology have been historically grounded in political self-interest or commercial charters, casting doubts on new efforts; and partly because the industrialized countries and international lending centers do not encourage LDCs to pursue non-nuclear and non-electric energy options. Meanwhile, the developed countries continue to consume ever-larger fractions of the available world oil, not always unmindful of the fact that their increasing consumption and inadequate energy policies are forcing the LDCs into a "do-or-die" dilemma with respect to nuclear power.

Challenges to the political, ideological, and institutional mechanisms that govern the transfer of technology from industrialized to developing nations—frequently dubbed "neo-colonialist"—are too often met with superficial "anti-technology" accusations. Ironically, much of this labeling originates in the West by those whose interest it is to legitimize the status quo.

We do not agree with those who argue that the Third World should do without high-level technology. Nuclear technology, however, is more expensive, more dangerous, and more difficult to manage than most high-level technology. As such, it deserves much more attention. Technology transfer, as we have so often learned the hard way, is not only the transfer of gadgets and machines; it is a complex exchange of cultures and ideologies, mechanical power and political power. In a most fundamental sense, the current pressure for so-called "appropriate" nuclear technology in the Third World may stem from the fact that such a technology attacks only the symptoms of energy starvation, leaving causes intact.

VI
U.S. Controversy About the Export of a Nuclear Reactor to the Philippines

A report received from the Center for Law and Social Policy in Washington, D.C.

Six environmental organizations filed a lawsuit immediately following the Nuclear Regulatory Commission decision granting permission to Westinghouse Electric Corporation to export a 620 megawatt nuclear reactor to the Philippines. The Petition for Review, filed with the U.S. Court of Appeals, contends that the NRC violated its responsibilities under the Atomic Energy Act, the Nuclear Non-Proliferation Act and the National Environmental Policy Act by approving the export.

Clifton Curtis, spokesman for the organizations, stated that "we are shocked by the fact that the NRC is turning its back on assuring the safety of reactors sold abroad. The NRC has clearly violated its duty to review the common defense and security, safety, health and environmental risks posed by the exported reactor. This plant is a disaster waiting to happen." Mr. Curtis added that, "A major accident at the reactor would endanger the lives of millions of Filipinos and over 30,000 U.S. citizens living in the nearby area, including those Americans stationed at the Subic Bay Naval Base and Clark Air Force Base. If necessary, we will seek a preliminary order from the court to restrain the export of the reactor until a final decision on the merits has been rendered."

The Westinghouse reactor, which would be the first built in the Philippines, has stirred considerable controversy both here and abroad because of alleged deficiencies in both its design and site location. The site of the partially constructed plant is located 45 miles west of Manila in one of the most highly seismic regions of the world. It is within miles of several earthquake faults and volcanoes, including the active Mt. Natib, only 14 miles away.

At first, the plant drew little attention. The site was hastily chosen and construction was begun before any serious investigations of the seismic and volcanic risks were initiated. The first opposition to the plant came from local farmers and fishermen whose livelihoods were disrupted. But heavy intimidation by the authorities silenced all but a few courageous individuals in the academic and religious communities. In the spring of 1978, some 20,000 Filipinos signed a petition asking President Marcos to call for a review of the plan to build the nuclear power plant. The petition was largely ignored by the Philippine Government and the press.

The Philippine nuclear power plant was promoted by the U.S. Department of State and financed by a $664 million loan and loan guarantee by the U.S. Export-Import Bank. In a Senate floor discussion on October 2, 1978 (Cong. Rec. C 16839) concerning the Ex-Im Bank Amendments of 1978, Secretary of State-Designate Edmund Muskie stated that "the need for environmental assessments of U.S. foreign programs is illustrated by environmental and economic disasters associated with projects which did not undergo such examination." Citing the proposed Philippine reactor as an example of such "disasters", then-Senator Muskie stated that "The Export-Import Bank financed construction of a nuclear power plant in the Philippines on a site which had not been properly surveyed. The site is now dangerously close to a geologic fault and active volcanoes. The economic viability of the plant is also questioned."

At a February 1978 Congressional hearing on the Ex-Im Bank, Congressman Clarence Long (D-Md.) raised serious questions about the health and environmental dangers posed by the Philippine plant. At the same time the reactor became a matter of international controversy when the *Wall Street Journal, New York Times,* and the *Washington Post* reported payoffs by Westinghouse to a close relative and associate of the Marcos family, Herminio T. Disini. The investigation of the charges against Disini promised by Marcos was never carried out, and the U.S. Department of Justice declined to bring charges against Westinghouse.

Reacting to the Three Mile Island accident and mounting public concern in the Philippines, President

Marcos halted construction of the reactor in June 1979. He set up a commission of inquiry, which held the first public hearing ever on the reactor. On November 16, 1979, the "Puno Commission" found that the reactor was "unsafe", as it was based on a late 1960s design that had never undergone complete review either in the United States or elsewhere. While all essential construction at the site remains halted, Westinghouse is now negotiating with the Philippine government for a lifting of the ban. With the support of the State Department and the Export-Import Bank, Westinghouse has also placed steady pressure on the Carter Administration to approve the export license.

Last fall, the NRC solicited public comments on the Philippines' export license, but eventually rejected the many pleas to examine the deficiencies of the reactor design and the site. It refused to consider even the environmental information and health and safety data submitted by the State Department and gathered by the NRC staff.

"The problem of reactor safety is a serious one worldwide, particularly in developing countries. To date the NRC's position has been to close its eyes, in flagrant disregard of Congressional intent," said Curtis. Curtis added, "We believe that the concerns expressed by Secretary of State-Designate Muskie in October 1978 are even more valid now in light of the added information that has been entered into the NRC's hearing record in this case." Curtis, an attorney for the Center for Law and Social Policy, a public interest law firm in Washington, represents several of the groups joining in the suit, which include the Natural Resources Defense Council, the Philippine Movement for Environmental Protection, the Union of Concerned Scientists, the Sierra Club, the Friends of the Earth, and the Center for Development Policy.

Energy Is a Major Security Issue

Hilary Ng'weno

The energy crunch is definitely here and we do not have to wait for the 90s to feel its pinch. The question is what do we do about it? The conventional answer to that question is that we should conserve whatever energy resources or supplies we have or look for additional or alternate sources of energy. Ideally, we should do both. And given the fact that conservation or development measures in the field of energy take time to bear fruit, the time for working out meaningful conservation and development measures is now. I hope that by the end of this article it might become obvious that the crisis which Kenya faces in the field of energy is of a magnitude which makes its solution of urgent strategic importance.

What in the Kenyan context is a meaningful energy programme? Surely it must be more than one which merely tries to balance the equation between demand and supply, for some of the ingredients of energy demand in Kenya may not be worth supplying, at least not on the scale at which they are currently growing. And it may turn out after careful examination that some of the sources of energy supply which the country has traditionally relied upon to meet its energy demand may not be viable by the year 1993.

Kenya's energy demand is estimated to be growing at the rate of 6 percent per annum. That is, however, the overall growth figure. Oil consumption in terms of volume has in fact gone down slightly over the past two or three years, mainly due to price factors and events in the oil-producing countries of the Middle East, particularly Iran. Demand for electricity is estimated to be growing at an annual rate of about 8.5 percent, a trend which is expected to persist into the mid-1990s. Within the electricity energy sector itself there are differentials in demand growth. Industry demand for electricity is expected to grow at about 12.5 percent per annum, whilst domestic and commercial consumption will grow at around 7 percent per annum. Added to these differentials are those evident on a regional basis. Nairobi and its environs alone consume more than half of the

energy consumed in the republic in the form of electricity and oil. If one takes into consideration the fact that 85 percent of the energy consumed by Kenyans—that is, excluding firewood and charcoal—is imported, and that the country currently spends more than 1.8 billion shillings per year or a quarter of its annual foreign exchange earnings on the import of energy, then it is clear that a meaningful energy programme must begin with the question of equitable use of available energy resources. This is all the more important in view of the fact that most of the country's foreign exchange earnings come from agricultural exports and that for the foreseeable future agriculture will remain the backbone of Kenya's economy.

Half of the energy consumed in Kenya goes into manufacturing and related industries such as transport of manufactured goods or raw materials for factories. It is this high energy input into the industrial sector in Kenya which probably accounts for a good deal of the phenomenal growth of more than 14 percent per annum of Kenya's manufacturing sector. Industrialisation is certainly a major objective of the country's development strategy, and one would not like to suggest that a viable energy programme should starve other sectors of the economy of energy in order to conserve on foreign exchange expenditures. Yet it is ironic that as the manufacturing sector of the country's economy has been growing by leaps and bounds, agricultural production has been falling, and the consequences in the past few months have not been all too pleasant to most Kenyans. There is probably no cause and effect relationship between these two disparate developments of our economy, yet given the massive investments which have recently been made in the energy sector, which in turn is geared to serving mainly the industrial and urban-oriented areas of our economy, one may be forgiven if one wondered whether an appreciable improvement in Kenya's agriculture and national welfare may not have been achieved had a good portion of that investment gone into agricultural development directly.

I do not wish to leave the impression that the question I have posed is an academic one, or one which can be answered by such simplistic ideas such as the multiplier effect of investment in industry helping agricultural development eventually. Let us, for instance, take the investment which the country is at the moment making in such projects as the manufacture of power alcohol. Those investments are morally being justified on the grounds that they will cut back our reliance on imported petroleum. They will boost employment, it is said. And they will utilise a by-product—molasses—of a major agricultural industry. This is all true. But who is going to benefit from the end product of the power alcohol plants going up in western Kenya? The energy demand they are supposed to satisfy is that generated by Kenyans who own cars which can use high octane gasoline with which the power alcohol will be blended. The projected savings on foreign exchange at present prices are actually negligible, but the capital outlays are enormous. Between the two power alcohol projects at Kisumu and Muhoroni, the government of Kenya is committed to investments of nearly $70 million in terms of equity, loans and loan guarantees. Because of the capital-intensive nature of the projects, the foreign exchange outflow on purchases of machinery is colossal and it is immediate. Feasibility studies and cash flow projections notwithstanding, it is going to take a long time for this country to make good that foreign exchange outflow in any meaningful terms. And all in the interests of those few among us who are going to need the end products of these sophisticated chemical plants. Imagine what could be done with $70 million in public funds in the area of agriculture? Or even in the development of diesel or other sources of energy directed at the needs of the rural population of Kenya!

I chose these two examples of power development in order to demonstrate that it is not wise to deal with the total energy demand of the country and try to balance the demand supply equation without looking at the components of demand and supply. It could well be that after careful examination, some of the energy demands for which the country is spending such colossal sums to satisfy are not worth satisfying, or at least should not have such a high claim on the scarce resources which the country has at its disposal in tackling this major national crisis.

Lest I give the impression that conservation or development of new energy sources is easy, I would like to stress the constraints which exist in the way of Kenya working out a meaningful energy policy. The first and foremost of these constraints is lack of natural resources. Kenya, unfortunately, is not very well endowed with energy sources. The only natural source of energy that we currently exploit—fire wood—is in fact in danger of extinction. Unless drastic steps are taken to protect Kenya's forests, which cover only about 3 percent of the country's total land area—we are going to be in great trouble. Though we have been prospecting for oil for nearly 20 years now, we have not yet come across any hopeful signs of workable deposits. And at present there are no indications that we have uranium either. Theoretically, we have about 5,000 megawatts ready to be expolited from hydro and geothermal sources of electricity, but in practice, given the current pattern of investment, it is unlikely that we will be exploiting more than 40 percent of this capacity by the end of the century. Under such circumstances, conservation measures are difficult to apply effectively. The rural population for instance, cuts down trees for fire wood mainly because there is no cheap and easily available alternative source of energy. There is also at the moment no incentive for afforestation. Consequently, the dire struggle to hold on to the country's forest cover is at the moment in danger of failure.

On the industrial scene, many of our energy users are tooled with equipment and machinery which is wasteful of energy. Conversion to more economic technologies is expensive. There is also the problem of inefficient government bureaucracy, or sometimes corrupt officials in regulatory bodies which are supposed to help conserve

energy resources in the country. I have in mind, for one, the forestry department. Laws already exist which protect many areas in the country. Government officials charged with enforcing these laws have in the past shown a singular reluctance to enforce these regulations, with the result that some of the most valuable forests in this country have been decimated. So much so that now the president thinks that the only way to protect this country's forest cover is to put every tree, whether in private or public land, under presidential protection. I do not think that presidential protection of trees in a country which is so clearly threatened with the prospects of turning into desert should be necessary if forest department officials were doing their job diligently.

Then there is the life-style which many Kenyans are trying to adopt. Many of us do not think that a 1,000 cc car is adequate to transport us from one point in the country to another. It has to be a Mercedes or one of those shining but petrol guzzling monsters. Bicycles, which in many countries are a perfect solution to the problem of locomotion in developing countries, are frowned upon by many Kenyans. In the rural areas, appropriate technologies which would cut down on the consumption of expensive imported energies are ignored and labelled primitive. High pressure sales techniques used by foreign multinational suppliers of more so-called advanced technologies have ensured that wind mills, ox carts or simple irrigation techniques are by-passed in a vain attempt by Kenyans to catch up with the rest of the world in energy consumption. And when the will is there, there is no recourse to develop new or alternative sources of energy. Research into appropriate ways of harnessing such abundant sources of energy as the sun and the wind take money, time and brains, all of which we lack.

Faced with this dire set of circumstances, we have now placed ourselves and the fate of our country in the hands of foreign interest groups which are offering all manner of solutions to our energy problems, solutions which when put under the microscope look terribly self-serving to those who are offering them. These constraints do not however mean that nothing much can be done about the crisis in which we find ourselves as far as energy is concerned. There is a lot which we can do, but we must first convince ourselves that the energy crisis is real and that it is of a magnitude which calls for a totally different mental framework in order for solutions to be found, and found in time to avert a national catastrophe. If I use the word catastrophe, it is with deliberation.

Kenya's monetary Gross Domestic Product has during the past five or six years grown at the same pace as the growth in energy consumption. Our fast growing population—one of the fastest in the world—requires that we maintain or even increase the growth in our GDP. If, as statistics seem to suggest, the growth in our economy is directly related to energy consumption, and if supplies are going to be inadequate to satisfy demand by 1993, then we are headed to an eventual standstill in the economy. With a growing economy, we have had to face during the past six months alone a series of power cuts and food shortages. Imagine the consequences if the economy were stagnating or even backsliding. Given the current patterns of consumption, a cutback in energy consumption could very well trigger the catastrophic events which a slow-down in the economy portend.

Yet a cutback in the consumption of at least one form of energy—oil—is inevitable. The oil producing countries, for reasons having to do with their own national interests, are determined to cut back on production of oil. That will eventually mean a cutback on the supplies of oil to countries such as Kenya which have no leverage on the world oil market. What is even more disconcerting is that as production goes down prices will go up, which will create a painful double bind for nations dependent on imported oil for most of the way Kenya at present is. A cutback in oil supplies will adversely affect industry and agriculture in Kenya. This will in turn affect our ability to export and earn the foreign exchange with which to buy the now much dearer oil.

Multinational oil suppliers will no doubt be quick to assure us that whatever happens on the world oil market Kenya will always get her share of oil. That assurance is totally meaningless, for we are entering a period in the politics of the world where multinational companies, which have in the past claimed to belong to no one nation, are going to come increasingly under the pressures of their home governments in matters affecting oil. American-based multinational oil companies are going to react to the unfolding drama in the Middle East and the Gulf areas with American national and strategic interests uppermost in mind. The British oil companies will do the same in respect to British strategic interests. I don't blame them. Indeed, I expect them to act like that, for strategic national interests are precisely what those words mean, and executives of multinational companies are not likely to keep wearing their multinational hats when the strategic interests of the nations of which they are citizens are at stake. In short, it would be foolhardy in the extreme for Kenyans to be lulled into complacency about the energy crisis by any noble sounding assurances which they may be given by the oil companies which at present procure oil for Kenya.

One need not be a doomsday type of prophet to see what the consequences of dwindling energy supplies would mean for the economy of the country. All you have to examine are the consequences of the recent short-lived power cuts in the country. There are unconfirmed reports that some industries lost as much as 30 percent in production during the past few weeks due to power cuts. The power cuts have, in fact, given many foreign investors and foreign companies operating in Kenya food for thought. If it can happen in 1980 when there are still relatively abundant supplies of energy, they ask, and rightly so, what is it going to be like in the 90s?

Remember that the motives behind the foreign investors have little to do with the desire to develop Kenya's economy. They are based on the desire to make profits, quickly and painlessly. While it may have been true in the past that Kenya offered one of the best investment climates on the continent, the energy question

may be changing that view among foreign investors. In neighbouring countries new discoveries of oil or uranium are making those countries much more attractive propositions for investment than Kenya at present is. The independence of Zimbabwe could well swing the investment centre in eastern and southern Africa away from Nairobi to Salisbury, for Zimbabwe has all the energy that industry and agriculture needs for the foreseeable future. It has coal and it has vast hydro-electric resources. And despite its many years of civil war, its economy seems poised for great expansion. In other words, energy and energy alone could turn out to be the factor that decides whether Kenya remains an attractive proposition for investors and consequently maintains the kind of economic growth momentum to which we have become accustomed since independence.

The threat to Kenya which I am describing in terms of energy is to my mind much more serious than threats such as unemployment, external military aggression or others which we have had to contend with in the past. For the threat posed by the energy crisis compounds all these other threats and can ultimately lead to an economic, social and political breakdown of the fabric of society. It is a national strategic challenge, and like any strategic challenge, it cannot be met adequately except through a major reorientation of attitudes on the part of leaders and the mobilisation of national resources to contend with any eventuality that might arise. The energy challenge is on a par with the challenge of maintaining national security, and in my view it ought to receive the same kind of priority that we give to the establishment and maintenance of the country's military and security preparedness.

The first priority, to my mind, is therefore not the working out of elaborate measures to conserve energy or develop new and alternative supplies, but rather the inculcation into the minds of our leaders and planners that the issue of energy is of national strategic importance. Until we do so, it is not going to be possible to carry out the necessary measures to deal with the energy problem. In other words, I am not talking about an advisory coordinating body such as the National Council for Science and Technology, or some interministerial committee which monitors trends in the energy field. I am talking of a body with specific executive powers, in addition to regulatory powers, which can take all appropriate measures in dealing with the energy crisis. Co-ordination of the activities of various parties—both private and public—which may be involved in energy matters should probably be one of the functions of such a body, but ideally the emphasis should be on the ability to deal with emergencies and the psychological make-up of the men and women who work in such an organisation should be the same patriotic frame of mind which we expect of officers in the special branch or military intelligence organisations of our country. They must be men and women who put the interest of this country first and foremost in their work, and they must be men and women who both by training and temperament are willing to devote their whole life to the problem of energy in the country.

In the final analysis, of course, certain specific measures would have to be considered by such an energy body, or by the government in general, as forming ideal components of an over-all energy programme. I would like to end this article by making a few such suggestions about what I think might form the basis of such consideration.

First, I suggest that the country address itself seriously to the problem of afforestation. The proposed special presidential tree protection act ought to serve as an opportunity to re-examine the issue of the provision of energy to the country's rural areas in which the majority of Kenyans live. A total ban on the felling of trees should be imposed anywhere where a very comprehensive afforestation scheme has not been worked out. And even where afforestation schemes do exist, they should not involve the cutting down of ancient forests which have taken centuries to grow and their replacement by exotic species whose long-term ecological implications have not been ascertained. If need be, let's for a while import all our wood requirements—even for charcoal—while we urgently work out a comprehensive afforestation programme.

Because of the inevitable cut-back on oil supplies—a development which we have no control over—any conservation measures we introduce must be such as to shunt the scarce oil supplies to those sectors of the economy whose use of oil is productive. Thus, measures should be introduced, and introduced very soon, to curb the use of petroleum products for leisure transport in favour of public and commercial transport. As a matter of priority, passenger vehicles of capacities beyond a certain reasonable level should be banned from the country's import quotas and those owning them should be discouraged from using them unnecessarily.

On the academic front, it would be worthwhile setting up a whole new institution of higher learning devoted entirely to the problems of energy and their solution. It may be asked, why set up such an institution? Why not expand the engineering and science faculties of the existing University of Nairobi? My answer to that has to do with what I mentioned earlier about the requisite psychological make-up for dealing with the energy problem. The University of Nairobi has not in the past been known to be in the forefront of working out solutions to the energy problems facing this country. A totally new academic atmosphere is needed if the skills we shall require to cope with the energy problem are to be developed fast. In addition to its current efforts the government needs to provide incentives for conservation and the development of new energy resources. There is no reason, for instance, why new homes should not be required to have solar water heating facilities built into them. I know, it is claimed that maintenance of such facilities would be impractical, given the current deplorable state of maintenance engineering in the country. But it is not going to be possible to improve the state of maintenance engineering unless concrete demands for good quality maintenance engineering materialise. In any case, the sun must be the most obvious

source of renewable energy in tropic countries. It is ridiculous in the extreme that we are able to go for sophisticated chemical technologies of power alcohol production before we have explored the potential for solar energy in Kenya.

And while on the subject of power alcohol, it would be wise if the government could explore small or medium-scale energy technologies before sinking huge sums of public money into gigantic projects. The fermentation of grains or sugars to produce alcohol is something which can be done on a small-scale basis. *Chang'aa* brewers do it all the time. Decentralised investment in this area could ensure that the same quantities, if not quality, of power alcohol required are produced while at the same time a lot more people are offered investment and employment opportunities. There is one other major factor to recommend to small and medium-scale industries in the energy field. They are better vehicles for technological transfer. Let us not forget that big-scale industries, with their modern push button electronic controls, are poor transmitters of technological know-how. This is not to say that we do not need large-scale industries. It is merely to point out that the transfer of a complex multi-million dollar plant from the United States to Kenya is not necessarily the same thing as the transfer of the know-how which keeps such plants going. Small and medium-scale industries involve greater personal involvement by those who work on them. They lend themselves to greater adaption to local conditions and requirements.

I would also suggest that the government give priority to research and development in the energy field. I know government has put aside some money for this purpose, but I do not believe that the question is merely one of money. Most of the money earmarked by government in this field is for government research. It is my contention that very close co-operation is needed between the public and private sectors in this research and development effort. Through subsidies or tax holidays, the government can stimulate private research and development in the energy field, and through protective measures young industries can be encouraged to provide alternatives to imported energy.

Finally, considerations of foreign policy must also be taken into account when dealing with the energy crisis. Until now, though relations with oil producing nations, especially Arab members of OPEC, have been friendly, Kenya has not gone out of her way to safeguard her vital national interests by studiously cultivating warm relations with countries on whose oil exports this country's destiny still depends. We have chosen, instead, to deal with Arab oil producing nations through the multinational oil companies based in western countries. And what is ironical is that though western countries have done whatever is in their power to adjust their foreign policies to the energy realities of the world, we have tended to hang on to policies which are now very clearly unrealistic. The frequent pilgrimages which men like the president of France, the chancellor of West Germany, the foreign secretary of Britain and other important western leaders have been making to Arab capitals ought to be telling us something about the direction of changing international affairs and how they affect the energy requirements of nations big and small. And we should not be fooled into thinking that these pilgrimages by statesmen from the west are aimed at helping the small nations of this world. To help ourselves, we have got to make our own pilgrimages, at least so long as we are so heavily dependent on the oil that flows from the Middle East.

And in connection with this, we ought to take up several offers which have been made in the past by oil producing nations in the Middle East to sell oil directly to Kenya and not through intermediaries such as the oil companies. These offers have included substantial rebates currently not available to nations buying their oil through the multinational oil companies. One main constraint in taking up these offers at the moment is the ownership and management arrangement at the East African Oil refineries company at Changamwe in which multinational oil companies are heavily involved. That arrangement stipulates that oil for the refinery must be procured by the private oil companies who are partners in the refinery. Purely from a monetary point of view, the offers which several oil producing nations have made regarding government-to-government sales of oil would be worth taking up even if the cancellation of the procurement agreements with the oil companies involves the payment of penalties, for the offers involve concessionary oil prices whose benefits are going to become increasingly important as escalation of oil prices on the world market continues.

On a much more important level than mere money is the whole question of strategic control of the decision-making machinery that deals with such a life-and-death issue as energy. No one in his right mind would suggest that the special branch or army intelligence machinery of our country—indeed, of any country—should be in the hands of foreigners. The very nature of these organisations completely precludes participation by foreigners, however well intentioned. As I have pointed out earlier, the crisis we face on the energy front is on a par with the challenge of national security, and our whole mentality toward the weapons we choose to deal with the energy crisis should be the same as our mentality toward security issues. It is for this reason that I consider it important for Kenya to take full control of the refinery at Mombasa by buying out the foreign oil companies. Here I am not pleading for nationalisation as an economic policy; I am calling for maximum control by Kenyans of an important facet in the country's energy situation.

Please, in all this let us keep in mind the fact that the oil producing nations, especially those from which we import our oil, are determined to remove the oil companies from their current role as middlemen. Oil producing nations with diverse political traditions such as Saudi Arabia and Iraq or Libya are now developing their own oil transport systems. Increasingly, many of them are making arrangements to sell oil directly to governments, not through private multinationals. Indeed, the main

reason why European statesmen have been making pilgrimages to the Middle East of late is to ensure that their respective nations can strike oil deals before other nations do so. In other words, whether we like it or not, we will sooner or later have to deal directly with the oil producing nations. We might as well arrange matters now in such a way that both the timing and the direction of those dealings are entirely under our control when that eventuality arises.

There are many other suggestions that one could make in this whole area of energy, but as I said earlier, the most important priority facing the country is for our leaders and planners to adapt a dramatically new attitude of mind in respect of energy problems. We must begin treating the energy crisis the way we treat our national security. Unless we do that, we are not likely to avert the terrible fate which lies in store for all nations whose current energy consumption patterns bear little relation to the supplies of energy these nations can secure in the future.

VII
Third World Energy Strategies

This article appeared in the August 1979 issue of the *Atom*, London, UK. Reprinted with permission.

James Daglish

Aspiration and practical reality clashed head on during debates at a Royal Institution Forum on Third World energy strategies and the role of the industrialised countries in London in June. What emerged at the end was a broad measure of acceptance that the future role of nuclear power worldwide would lie more in substitution for fossil fuels in the developed world, thus freeing especially liquid fuels for static and mobile applications in the lesser-developed countries, than as a prime energy source in the Third World.

The key debate on the nuclear option occurred on the afternoon of the first of three days of discussion between 170 participants from 30 countries, including representatives of many of the international agencies with a direct interest in the problems of the Third World. Dr. Bernard Spinrad, of the International Institute for Applied Systems Analysis, based at Laxenburg in Austria, presented a paper by Wolf Häfele, Arshad M. Khan and himself which argued that there were limits to what could or prudently should be done. Economics affected choices among forms of energy use, between energy-intensive products and activities and those that substituted for other resources, and with regard to investments that should be made in the energy system and other parts of society. Other potential limits existed in the form of risks and environmental effects.

"With regard to risks of injury to people we have not been able to identify any technology that seems to be too risky to use," the paper said. "Nuclear energy is most often attacked on this score, but it is in many ways better than competing technologies; for example, its routine operation causes less morbidity than getting the same energy from coal, and catastrophic accidents are less likely and less damaging than those associated with hydroelectricity. We have concluded that the observable misgivings that people have about nuclear power are really based on the fear of something else. We think that the cause may really be a displaced fear of nuclear war, and therefore would go so far as to say that a condition on acceptance of nuclear power is a world at peace. It goes without saying that a world always at war would be a grim place, and a world after a major nuclear war would be a hard one."

The IIASA had studied the effects of energy on climate, with unsurprising conclusions: very large energy use could have important local climatic effects on regions of high concentration, but global effects were not significant unless the energy were released at concentrated *and* poorly chosen locations. "On the other hand, we have no reason *now* either to be complacent or worried about the effects of carbon dioxide on the world climate, but it seems certain that if we pour a great deal of CO_2 into the atmosphere very severe effects would ensue. This means that there are limits of prudence above which, with present knowledge, we should not burn fossil fuels, particularly coal."

For the world as a whole, the IIASA had tried to visualise each supply option pushed as far as it could go—reasoning not that all options would be exploited fully, but that each option must be examined to see whether it could take up slack. Traditional fuels would continue in use, but there was not much fossil fuel remaining that was cheap and clean. In the next 50 years the IIASA saw a transition from cheap, clean oil and gas to more expensive and dirty oil and coal products. The era of fossil fuels would be limited by the cost of refining and using them for purposes other than those for which they could not be substituted, such as transportation and general purpose energy for dispersed populations. Ultimately, they saw a combination of gasoline, kerosene and methanol, all derived from coal hydrogenation, as the liquid fuels of major use.

"Central station nuclear power is the technology which is in the best position to supplement fossil fuel over the next half century," said the paper. "The technology for burner (thermal) reactors—light-water and heavy-water cooled ones principally—is commercial now. In most of the world they represent the most economical means of generating electricity. Advanced systems which permit much higher temperature operation, either for chemical processing or for more efficient conversion of heat to electricity, are at the threshold of commercialisation. These are high-temperature, gas-cooled reactors and liquid metal-cooled fast breeder reactors. The breeders are of special significance because their use lets us consider *all* the uranium and thorium in the world as a fuel. Without them nuclear fuel is only 1 to 2 percent of the uranium mined, and we could only afford to mine the more concentrated uranium deposits."

The IIASA had plotted a scenario that culminated in the emplacement of reactors capable of delivering 17 terawatts of thermal energy by 2030, in a mix of types including HTRs for chemical process use as well as electricity generation and fast reactors. Such a scenario could exist only under certain conditions: for example, the public acceptance of what to the IIASA was a certainty, i.e., that questions of reactor safety and nuclear waste disposal were resolved or resolvable. "Because we believe that these issues are already resolved in the technical sense we have concluded that these concerns are indicative of a need to resolve the trickier institutional questions of nuclear weapons proliferation, and the ultimate question of the elimination of war, particularly large-scale war. In saying that the safety issue is resolved we do not, of course, claim that accidents will not happen. Harrisburg shows that they will. The claim is more modest: that the accidents that will happen will not turn out to be big burdens on society. Harrisburg shows that, too."

Without nuclear power, what? Central station solar power could perform many of the same functions, but it seemed that its potential could be realised only one or two decades later than that of nuclear power, and that by 2030—the end of the period considered in the scenarios—it would only be beginning to become a supply option at the terawatt level. All in all, it was prudent however to expect that the world would use both nuclear and solar power.

Big items among the other "renewable" energy sources were wind, hydroelectricity and biomass. Most wind applications and the largest part of hydro lent themselves to utility integration rather than small-scale use; biomass, on the other hand, had some applications of significance at both the centralised and dispersed level. A lot of "renewable" energy was technically accessible; renewables might be expected to contribute 7 percent of the energy needed for electricity production in developing countries in 2030, and 16 percent of the non-electrical energy demand.

On both a "high" and a "low" scenario for future development the developing regions were essentially expected to recapitulate the experiences of the advanced regions with respect to nuclear power, with a time lag of perhaps 30 years, the time required to build up the appropriate infra-structure. With respect to the IIASA study as a whole, the paper recorded "some disappointments." First, it had been expected that they would see a little of the new world in their look at the future as a clean and prosperous one. Instead, they had had only tantalizing glimpses. Mostly what they saw by the year 2030 was the same old world improved in some ways but showing some patches in other ways. In particular, they had some misgivings about the amount of fossil fuel that would still be being used—"the CO_2 problem, or simply the general environmental impact problems of coal and dirty oil could hit us fairly suddenly. . . . We think nuclear power is our best crutch, but we are weakening it these days instead of strengthening it.

"One aspect of disappointment is the still slow progress that developing regions will make in catching up with advanced ones. The progress is there, but it is not really sufficient. Part of the story is that world trade will depend for a long time on capital formation in advanced regions. If advanced countries do not grow, they do not have so much available to invest in developing regions. Our low scenario represents such a 'dragging on'. Yet we are troubled. Is this the way that world trade should be structured? Are better ways practically achievable?

"Finally, one thing is clear. The world *must* make *meaningful* investments. By meaningful, we mean investments that create endowments for the future: capital stock that makes it possible for our descendants to live without making continued demands on nature, and without making continued demands on human toil. Such endowments are exemplified in the energy field by two types of systems: breeder reactors, and central solar stations. They will be costly in present capital, but we know in our bones that it will be even more costly to wait before we start building."

Growth or stagnation

José Goldemberg, of the University of São Paulo, Brazil, agreed with Dr. Spinrad that in principle a good

case could be made for nuclear power in developing countries. Even with the most stringent efforts to achieve energy conservation their energy consumption was likely to increase fourfold in 25 years; the uneven distribution of oil, gas and coal reserves around the world did not particularly benefit many of the lesser developed countries (LDCs), with the exception of the OPEC countries, and by the year 2000 would put some of them in a position of increasing dependence on energy imports. Against this background the role of nuclear power in the LDCs could be envisaged as twofold: as a substitute for oil and gas and possibly coal which would otherwise be required for electricity production, and as a means of avoiding an overwhelming dependence on imports. It was technologically mature. But in the last few years we had seen a clear decrease in the expected role of nuclear power: IAEA projections made in 1977 were about half those made in early 1974. The decrease in the potential of nuclear power in the LDCs in the face of a fivefold increase in the price of oil was a paradox calling for an explanation.

Assumed relationships between growth in gross domestic product and growth in electricity demand in the earlier study were based essentially on cross-country consumption and income data from the 1960s, and were thus subject to biases which led to an understatement of electricity needs when projections were based on an assumed growth of real income. On the other hand, the world-wide "normal" relationship assumed a certain pattern of industrial structure changes—particularly the production of energy-intensive materials—as economic growth proceeded. If, as seemed likely, the developing countries were not following the historical pattern, then electricity consumption would be overestimated.

"As is well known the fraction of energy used as electrical energy is increasing on a world-wide basis and has reached a 'plateau' in the 30 percent mark in developed countries," Goldemberg said in his paper. "In developing countries the level reached is approximately 25 percent, being in general lower than that. Unless many LDCs turn to the massive use of electricity—which is very unlikely—electricity will not be required as it is in the developed countries."

The 1977 IAEA survey was, of course, subject to constant revision, and it acknowledged that "estimates of installed capacity till 2000 were too high for a number of reasons:

1. The diminished growth in electrical demand that has occurred in many member countries during the last several years;
2. the extremely high cost of nuclear plant construction, which has placed financial burdens on countries with existing nuclear programmes;
3. the present lack of commercially available small and medium power reactors, which many of the smaller member states would need in order to expand their electric power systems; and
4. the growing awareness of member states that more attention should be paid to exploitation of indigenous energy sources."

The paper continued: "It is becoming increasingly clear that even the most sober of the projections for the role of nuclear power in LDCs will not be fulfilled by the year 1990. . . . Our number . . . assumes that the nuclear programmes of the largest nuclear countries among the LDCs (Brazil, Mexico, Iran and India) will simply stagnate at their present levels. These four countries account for approximately 50 percent of all the nuclear market in LDCs." It seemed that nuclear energy would supply at most 40,000 MWe of installed electrical capacity in 1990. In addition to emotional and strictly economic considerations, which did not favour nuclear power, there was a growing realisation that self-reliance was one of the most cherished goals to be achieved by most countries in a complicated world. Self-sufficiency in energy supplies could be achieved in a few of the large LDCs using indigenous supplies such as coal in India, hydropower in Brazil and gas and oil in Iran; it was becoming clear that as a group non-OPEC LDCs were self-sufficient in *all* primary energy sources with the exception of oil, and regional cooperation among groups of LDCs could lead them to energy independence in most areas. This was particularly true in the case of hydroelectricity, whose role had been grossly under-estimated "not only in most countries, but in most regions, probably due to the heavy marketing for nuclear energy conducted by the vendors and the IAEA technocrats."

Rationale and impact

Jorge A. Sabato, of the Fundacion Bariloche, Argentina (but writing in a personal capacity) and Jairam Ramesh, of the International Institute for Environment and Development, Washington, D.C. (also in a personal capacity), presented the third and last introductory paper to this session of the forum. In it they noted that beginning in the early 50s research and development on nuclear energy was introduced in several developing countries, and extensive programmes to harness nuclear energy for the production of power, and in agriculture, industry and in medicine, were set up. About a dozen countries including Argentina, Brazil, Mexico, India, Israel, South Korea, Egypt, Yugoslavia, Spain, the Philippines, Taiwan and Turkey had been involved in such programmes for more than 20 years; many had now gone beyond the research reactor stage and had sizeable nuclear installations including power reactors and significant capability in several phases of the fuel cycle.

Over the last five years or so, however, the policy of developing nuclear capability and infra-structure had come under heavy attack in both developed and developing countries. The main arguments used against nuclear power were that it was "a dangerous and highly risky socio-technical system that is vulnerable to political and social instability and poses both short- and long-term health hazards;" that the establishment of a

nuclear programme, ostensibly intended for peaceful purposes, might nevertheless have weapons manufacture as an implicit long-term objective; that nuclear programmes were not of immediate relevance in meeting the basic needs of the masses in the developing world; and that an important rationale for nuclear programme development—namely, the production of electricity cheaply and efficiently—was lost when other hitherto neglected sources of energy within the developing world were considered seriously. Moreover, these alternative options, including hydro, solar, geothermal and biomass energy, could be decentralised and made compatible with the local ecological and socio-economic milieu.

In the more advanced of the LDCs emphasis has been given to the maximum participation of local industry and local involvement in all stages of the fuel cycle. Power reactors had been introduced after in-depth feasibility studies whose technical quality was excellent —as good or as bad as any others produced in the developed world. Therefore, in terms of the accepted development model and of the scientific and technological information which had been available the building of power reactors had been quite rational—at least as rational as the establishment in the same countries at about the same time of industries like iron and steel, petrochemicals, heavy machinery and automobiles. On the positive side of the balance the actively developing countries had been successful in fulfilling their original objectives of developing self-reliance. On the negative side, however, nuclear power required an extensive industrial base and a highly trained cadre of experts for its proper operation; through nuclear power a country was importing a life-style which led to greater technological dependence; there was a critical problem of 'opportunity costs'—the development of nuclear power excluded the possibility of other options, so that technologies more appropriate to developing countries might be neglected or even discarded, and so on.

"Summing up the negative side of the balance, the 'anti-nukes' claim that nuclear power is a very bad choice for LDCs on all counts, a technology that helps to perpetuate the worst aspects of dependence and backwardness. We arrive now at the fundamental question: is the final balance positive or negative? The debate is far from being closed and in fact it never will be, simply because conditions and circumstances keep changing and at an accelerated rate. We believe, however, that in the 1950s it was the right decision, especially because at the time the positive side was more in tune with the political framework and some of the negative aspects were simply unknown.

"But what was good for the 50s could be bad for the 70s and 80s. It could be that for some countries the 70s are the 50s, the various syndromes (leading to the decision to go nuclear) are still present, and the positive side is valid. On the other hand, there may be some countries for whom the situation has radically changed so much so as to abandon or stop existing nuclear programmes."

The discussion which followed the presentation of these three papers ranged from the potential for dung burning to the Harrisburg accident, from the provision of energy to drive tractors in rural areas to the political considerations underlying nuclear weapons proliferation. Dr. Spinrad opened by reiterating his view that the use of nuclear power in the developed world was one of the best and easiest ways of lowering the pressure on the fossil fuel market, with consequences which benefited the whole world. Dr. Goldemberg said it was emerging powerfully that the attempt to escape the confusion in world energy was a growing force in the LDCs, thus independence from external imports was a powerful factor. "I think there are strong reasons to believe that there is more hydropower in the world than is allowed for in the projections," he said. "Then large-scale biomass is becoming important. In 1985 half of the gasoline used in Brazil will be gasohol. There is renewed interest in using other biomass to produce fuels. . . . The LDCs do not have to follow the mistakes of the developed countries. A sizeable fraction of them could achieve a state of affluence through another route. It was a dream of scientists a few years ago, but not any more. Fuels derived from biomass are a reality, and I think they will be a reality in the United States very soon."

Paul Sieghart, speaking as a member of the Groupe de Bellerive, asked Dr. Spinrad for his views on one constraint on the nuclear option not mentioned in his opening: measures to achieve non-proliferation of nuclear weapons. "The conclusion which always seems to be reached is that the two ultimate long-term major constraints [in energy] are the CO_2 problem in the case of the burning of fossil fuels, and the proliferation problem in the case of nuclear energy—very difficult to judge, full of uncertainties, full of factors which it is difficult to quantify or run experiments on."

Dr. Spinrad said he thought the danger of igniting a war by competition over resources was "far greater than the danger of a small country getting a nuclear weapon and by some rather mysterious method starting World War III with it. That is at least my private opinion. It can be best summed up by saying that a step which will ease the energy situation does much more in lowering the chances of starting a war than a step which may make a war a little worse."

Efraim Friedman, of the Energy Office of the World Bank, pointed out that the promise of cheap energy from nuclear plants of small unit size—suitable for developing countries—had not materialised. The cost of nuclear power plants had escalated; instead of the 'learning curve' leading to lower and lower cost, it had led to higher and higher cost. In economic terms the situation was as Dr. Goldemberg had described it. Until other energy resources were exhausted, nuclear power would be a last resort solution. "Nobody loves it," he said. "I love nuclear power," Dr. Spinrad retorted. "I have spent a whole career in it. . . . It may very well be that the scaling law, which admittedly has resulted in a great deal of problems, was the wrong scaling law in the first place. We have recently

heard from the General Electric Company, who have been doing research on the size of nuclear power plants which gives the minimum cost, and it appears that it is probably less than 600 megawatts."

Returning to the proliferation issue, A.J. Lorimer, of British Nuclear Fuels Ltd, pointed out that no state had gone to weapons through civil nuclear power. "Proliferation is a serious world problem," he said, "but it will not go away by saying we will do without nuclear power."

Carlos Suarez, of the Fundacion Bariloche, Argentina, noted that when they discussed the various energy options, each tried to demonstrate that this or that solution was the only one. "I think that that way we never arrive at any agreement that corresponds with reality," he said. "We should try in each system to analyse which is the best combination of the different energy sources, taking into account all the natural resources, and the technology, and the human resources and the capital resources we have in each country, before we can give general answers to the problem. It is necessary to have an open mind. If you do not have hydro or other things, you can use nuclear energy; but if you want to give electricity for lighting or cooking in a rural area of a less developed country, nuclear doesn't matter for at least 50 or 60 years. You can't cook with nuclear energy in rural areas. You need to go another way."

On the other hand, Shishkir K. Mukerjee, of the Energy Systems Group, Indian Institute of Management, said "I don't think the right approach today is to stop nuclear power. I think it is better that we take a very vigilant approach toward things, and [ask] through the technological establishments that these problems should be worked out, so that maybe eventually we come to a technology which would be economic in maybe 20 or 30 years, and may be benign if it is not today. On a long-term basis we have only two sources of energy. One is nuclear, and one is solar. For that reason I think we should not totally close the nuclear option.

"The question is, if you stop generating electricity from nuclear resources, does that stop proliferation? Does that stop the danger of nuclear war? No. So then, why do you want to deny developing countries the advantages of nuclear power, if it does turn out to have advantages? We have to realise that it is a sophisticated technology, and just as any other there are dangers involved with it—just like the dangers of windmills. Ultimately the conclusion comes to this: that as one of the sources we should keep the energy option open, and try to bring down the cost if possible."

A farmer plowing his fields in the Oaxaca Valley, Mexico. *United Nations*

Part II
Plans for the Follow-up of the Conference on Faith, Science and the Future

Introduction

In the 16 months since the Conference on Faith, Science and the Future there has been considerable reflection and writing on the results, and how best to continue the consideration of the themes and questions posed there. The publication of the Conference Report in May 1980 started a new stage of work as churches received the detailed findings of the conference sections and were invited to respond to the many ideas and recommendations.

The Working Committee on Church and Society (which was responsible for preparing the 1979 Conference) met in Stuttgart, Federal Republic of Germany May 27 to June 2, 1980, to review the first responses to the Conference and to prepare a follow-up programme. Their report was presented to the WCC Central Committee by Metropolitan Paulos Gregorios, Moderator of the Church and Society Working Committee, and two scientists active in the Conference and in the followup: Professor Enilo Ajakaiye, a Nigerian Physicist, and Professor Jonathan King of MIT. The text of the Working Committee's Report and the statements of the three speakers are published here together with the actions of the Central Committee which "endorsed the overall plan proposed in this report and the time-schedule outlined therein."

The most controversial action in the report concerned the recommendation of the 1979 Conference for a five year moratorium on the construction of new nuclear power plants. In a close vote (46 for, 34 against, with 12 abstentions) the Central Committee of the World Council of Churches decided to endorse the call to the heads of government for such a moratorium.

In a separate action on *Nuclear Disarmament* the Central Committee noted the recommendations of the 1979 Conference and of the Church and Society Working Committee on "Science for Peace" and issued its own statement of support which is reproduced here. The Central Committee also requested Church and Society and the Commission of the Churches on International Affairs "to arrange jointly an international Public Hearing on the current threat to world peace with special focus on the increased danger of nuclear war, where authoritative witnesses can be cross-examined in an effort to assess the present situation. . . ."

Preparations for this Hearing are already under way and future issues of *Anticipation* will report on the progress of these plans.

United Nations

Strategies for the wise use of energy are critical to the future of the Third World.

Note to the Central Committee of the World Council of Churches

The Working Committee on Church and Society met in Haus Birkach, Study Centre of the Church of Württemberg, Stuttgart, FRG, May 27 to June 2, 1980, to review the responses to the World Conference on Faith, Science and the Future at MIT, and to prepare the promised follow-up programme on the Conference. A list of those taking part in this meeting is attached to our report (see Appendix).

*The Committee received written and oral reports on the responses to the Conference and had lengthy discussions on the various reactions. The Conference has already provoked a large discussion and it is expected that there will be more reflection and evaluation of it now that the Official Conference Report has been published.**

Two points are clear to the Working Committee: (1) the Conference has aroused the keen interest of many theologians and scientists and (2) the churches and the World Council need to continue their work on these questions. As the Reports of the Conference and of the Working Committee make clear we are still only beginning to understand the scope of the challenge posed by modern science and technology. It is in this spirit that we ask for your consideration of and support for the follow-up programme proposed.

Metropolitan Paulos Gregorios, Moderator
Professor Charles Birch, Vice-Moderator

* *Faith and Science in an Unjust World*, Vol. 1, Plenary Presentations, ed. by Roger Shinn; Vol. 2, the Report of the Conference, ed. by Paul Abrecht (Philadelphia: Fortress Press, 1980).

Report on the 1979 World Conference on Faith, Science and the Future, and Recommendations for its Follow-up

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from the Working Committee on Church and Society,
Stuttgart, Federal Republic of Germany
June 1980

INTRODUCTION:

The World Conference on Faith, Science and the Future was different from any previous ecumenical study conference.

— It was the largest ever held, involving more than 900 persons, including official participants, science students, observers, accredited visitors, staff and journalists. The bulk of the official participants were selected by member churches.
— It had the largest representation of scientists of any ecumenical conference. They came from many scientific disciplines and brought before the churches concerns and view-points which had not previously been considered.
— It dealt with many complex issues in an exploratory way and did not expect to achieve a final solution of all the ethical issues and challenges posed by contemporary scientific and technological developments.
— It enlarged ecumenical thinking by taking up the questions of ecological and technological sustainability as well as those of social justice and participation. (The sub-title of the Conference was The Contribution of Faith, Science and Technology to the Struggle for a Just, Participatory and Sustainable Society.)

The official report of the Conference, entitled *Faith and Science in an Unjust World,* has now been published in two volumes.* This 600-page report shows the wide

* *Volume 1, Plenary Presentations; Volume 2, Reports and Recommendations.* Reference to the Conference Report will indicate the volume and the page number. For example Volume 2, page 165 appears as 2:165.

range of issues and concerns which the Conference has posed for the churches.

At its meeting in June 1980 the Working Committee on Church and Society sought to summarize and assess the discussion at and after the Conference, to review the many suggestions and recommendations of the Conference and to propose the best ways of continuing to build on it. The Committee has sifted through the numerous suggestions and recommendations in the report and selected those which it feels deserve particular attention in the follow-up programme.

Our report to the Central Committee has seven sections. It begins with (I) consideration of a theme that ran throughout the Conference, "Scientific Knowledge as Power—Its Just Distribution in the World Community." It continues by looking at some of the specific areas of concern at the Conference. (II) Energy Issues, (III) The Science for Peace Resolution, (IV) The Biological Manipulation of Life. It then turns to another of the issues runnning through all the work of the Conference, (V) Politics, Economics and Technology of the Just, Participatory and Sustainable Society. It then goes into the specifically theological issues, (VI) Humanity, Nature and God, following which it examines the significance of all these issues for (VII) Science Education. In the final part (VIII) there is a compilation of the recommendations for follow-up which the Working Committee feels are central and critical and within the available resources of the sub-unit on Church and Society, and those sub-units of the WCC which may wish to share in this follow-up programme.

I. SCIENCE AND TECHNOLOGY AS POWER

1. One of the central concerns of the Conference at the Massachusetts Institute of Technology was scientific knowledge as power and technology as its tool, and who controls them. The Conference discussion focused on three areas in which such power is exercised: over people, over cultures and over nature. It was difficult for many at the Conference to keep these three facets in view and to regard them as equally important. For example, some wanted to stress the primacy of the just distribution of technological resources, others, the destructive effects of technological power on culture or nature. As a result the Conference frequently had difficulty in integrating the three in a conceptual and practical plan of action. The Working Committee is persuaded that this work of integration should be an important part of the follow-up of the Conference.

A. *Science and Technology as Power over People and Nations*

2. For those who feel oppressed by technological systems, whether controlled by foreign or indigenous groups this is the most important dimension. It takes on special urgency in view of the tremendous expansion in the power and functions of nation states. A large group of participants from countries in Africa, Asia, Latin America, the Middle East and the Pacific expressed very clearly their dissatisfaction with the "historical and current use of science and technology by industrially and technically advanced societies to serve military and economic interests which have brought about great suffering to the people of the Third World" (2:171-2). And many of the science students present said that in their careers they would refuse to work in situations where "science and technology are used as means of domination."

3. The radical challenges to the scientific community disturbed many western scientists at the Conference who did not see themselves as "oppressors." But the majority of the Conference agreed that science and technology cannot be considered in isolation from their economic, social and political context. The present world economic system with its maldistribution of scientific and technological power and its international division of labour is based on exploitation, which takes many different forms (2:136-137). Problems arise in both the centralized capitalist countries and in the socialist countries from concentration of power within large private or public corporations, military groups and state bureaucracies, and from the lack of participation in decision-taking.

4. The Conference spent much of its time in examining ways by which the scientific community and the churches might more effectively participate in the struggle for a just world community through (a) supporting the claims of the Third World countries for greater access to science and technology, and (b) opposing the concentration of the resources of science and technology in the military field.

5. There were few illusions about the enormous task ahead of us. (The U.N. Conference on Science and Technology for Development (Vienna, August 1979) which followed upon the WCC Conference at MIT largely failed to make a breakthrough in developing a political programme for more equitable distribution of science and technology and for effectively strengthening indigenous scientific and technological capacities in the developing countries. A UNESCO study of 1979 reveals that 97.3 percent of funds for research in science and technology are expended in the developed industrial nations, and only 2.7 percent in the countries where 65 percent of the world's population live.)

B. *Science and Technology as Power over Cultures*

6. Several reports of the Conference (especially Section I and X) recognized an ambiguity in the power of science (2:10, 2:157ff.). The scientific-technological culture creates an acute identity problem and cultural alienation for many in all societies. In many developing countries people recognize their absolute need for science and technology to solve the problems of poverty and hunger, illiteracy and unemployment. At the same time there is a growing reaction against the leadership of an elite influenced by the secular, scientific-technological culture imported from the West.

7. Representatives of the other religions at the Conference showed the problems which arise from the rapid introduction of Western science and technology into their indigenous cultural and religious systems with their distinctive spiritual visions. The question is, can the vision and practice of science and the vision and practice of these religions interact creatively? Can this interaction be a corrective to the scientific and technical spirituality and make its expressions and forms more beneficial for humanity? And can scientific and technical rationality help the other religions to discover new dimensions of human community and of the spiritual destiny of humanity? These and related questions were taken up by the Conference in its Section II on "Humanity, Nature and God" and will be reported on in detail below.

C. *Science and Technology as Power over Nature*

8. The Report of the Conference affirms the high value of science in overcoming want, misery, ignorance and ill health, but declares that while "Modern science and technology have achieved great success in the knowledge of nature and its use for humanity . . . the technological treatment of nature made possible by modern science has increased humanity's oppression and exploitation of nature to a degree previously unimagined" (2:29).

9. The questions that arise from this situation are crucial to the Christian Church. Its biblical view of nature which it attempts to live by is now challenged by the immense power that science and technology have over nature. The Conference Report describes the new situation as follows:

> "The cultural context has radically changed since biblical times. In the biblical period humanity was confronted with an overpowering nature. The command to rule the animals and to subdue the earth delivered people from fear and from the temptation to divinize or demonize nature, and encouraged them to overcome suffering and to build culture. The power relations have since been reversed by science and technology. A desacralized nature is in the power of humanity which is now able to destroy its own species and perhaps even all life on earth. Our own technological inventions and our social process are threatening to get the upper hand and to become as overpowering as nature once was . . ." (2:33)

10. The Conference also raised questions about the emergence of forms of technical power which seem to be inherently beyond human control, are morally dangerous and, some would argue, intrinsically evil. The ethical discussion became particularly acute in relation to the development of nuclear and genetic technologies. These concerns are now expressed by scientists and technologists themselves in contrast to earlier periods when the question of limits to science and technology was raised by religious people and based upon a traditional and static understanding of human morality and nature. In its Report on Humanity, Nature and God, the Conference sought for a deeper understanding of the role and limits of humanity in the exploration of nature.

11. In practically every branch of modern science and technology the question as to whether to oppose forms of research and development which may turn out to be socially destructive is being raised in a way which shocks those accustomed to an unchecked and uncontrolled scientific and technological search for "truth." The pursuit of knowledge for its own sake, regardless of the social consequences, is no longer acceptable.

D. *Participation as a Challenge to Science and Technology as Power*

12. As science and technology achieve ever greater power to affect the destiny not only of large groups of human beings, but even of the whole of humanity (nuclear technology, biological manipulation, bacteriological or climatological warfare, etc.), the general public is becoming increasingly unwilling to leave the control of science to the scientific community, or to an elite of political, military or business leaders.

13. The Conference affirmed "the right of society to exercise ethical control of scientific and technological activities" (2:25) and the right of all interests and all persons affected by scientific-technological decisions to be adequately represented in the decision-making process. It also recognized the need for safeguards against corruption of the participatory decision-making process by powerful lobbies and by greed or favoritism (2:25).

14. The Conference further declared that the churches have a special responsibility to make sure that the voices of the oppressed and suffering are heard and their interests defended. Even nature, itself a victim of exploitation, needs a defender of its rights (2:34).

15. Systems of participatory control will take different forms in different societies. This is more than a matter of legislation; it involves training and equipping the oppressed to perceive their true interests and to defend their rights. This is especially true for developing countries which seek both access to science and technology and the means to evaluate its social consequences. Even in technological risk assessment the general public should not be at the mercy of the official experts, but have independent access to information and capacity to evaluate it.

16. Talk about the control of science and technology raises for some the spectre of the Church silencing Galileo and others. The Conference was agreed that the freedom of science must be defended in order that it may fulfull its responsibility to humanity. However, the tension between freedom and the need to control technological power in the interests of society cannot be avoided. The Conference did not believe there was a simple formula to ensure true participatory decision-making. Rather it stressed "the great need of communication among experts and between experts and the general public" (2:154). This would include:

"i. the ethical responsibility for scientists to communicate knowledge clearly . . .
ii. the ethical responsibility of citizens to inform themselves . . . using individual and communal strategies . . .
iii. the ethical responsibilities of governments to make it physically possible for their citizens to inform themselves . . .
iv. the ethical responsibility of international organizations to spread information among different countries and to break down monopolies of information . . .
v. the ethical responsibility and the freedom of non-governmental institutions (churches, universities, research establishments) to present their views to a wider public."
(2:154)

17. The Conference recognized that the participation of people in decision-making "becomes exceedingly difficult within large and intricate societies" (2:155), but humanity must not cease to test new methods of participation "without which justice is incomplete and insecure."

18. Taking into account the recommendations of the Conference for more information and discussion of the social consequences of technology the Working Committee urges:

Recommendation I

That Church and Society sponsor a number of follow-up meetings in Third World countries with the aim of bringing church leadership, including lay-people and theologians together with scientists and technologists and others concerned to

(a) consider problems of technology transfer and its impact on traditional communities and cultures;
(b) assist in raising of public understanding of key technological issues facing their societies, and encourage local study and action groups;
(c) draw more scientists and technologists into a discussion of the critical issues of faith and social responsibility;
(d) discuss with theologians, pastors and theological students the problems which rapidly developing science and technology pose for their ministries;
(e) stimulate the preparation of programmes of education and information on critical issues of technology transfer, especially its military application.

(Leadership for these meetings would be provided by 1979 Conference leaders and members of the Church and Society Working Committee as well as Church and Society staff.)

Recommendation II

That Church and Society inquire into the possibility of creating a *Voluntary Task Force* of qualified and concerned scientists and technologists to assemble and distribute key facts and information on current developments in science and technology in the developed countries as these relate to the problems of technology transfer and the overall goal of a just, participatory, and sustainable society. This would require establishing an information and communication network among interested scientists, technologists, educators, business, government, labor, and church leaders in Third World and industrial countries. It would be considered a part of regional follow-up programmes that are developing in various parts of the world.

II. ETHICAL ISSUES IN THE WORLD ENERGY DEBATE

A. *The Debate about Energy Options*

1. The WCC has in recent years given attention to the ethical and theological issues connected with energy, both because of the intrinsic importance of energy and because it is symptomatic of many broader issues in the contemporary world. It is one focal point in any struggle for a Just, Participatory and Sustainable Society.

2. Following a recommendation from the Bucharest Conference on Science and Technology for Human Development (1974), the Central Committee of the WCC asked Church and Society to conduct an Ecumenical Hearing on Nuclear Energy which was held in Sigtuna, Sweden (1975). Later the Central Committee authorized Church and Society to be represented at a Conference of the International Atomic Energy Agency (Salzburg, 1977) and to convene a second conference on Ecumenical Concerns in Relation to Nuclear Energy (Bossey, 1978). The subject became one of the major areas of discussion at the 1979 World Conference on Faith, Science and the Future.

3. The recommendations from the 1979 Conference were substantially in continuity with the past work of the WCC. In the report of Section VI on Energy for the Future there were unanimous reaffirmations of: (1) the importance of conservation of energy throughout the world, but especially in the affluent, industrialized societies with their lavish consumption; (2) the moral necessity for redistribution of energy along with other resources for the sake of the world's poor; (3) the importance of the participation of people everywhere in decisions about energy policies.

4. In addition, two concerns received major attention: (a) there was a broadening of the issue from the focus on nuclear power to wider issues of energy, which had not been ignored in earlier work, but which now received greater emphasis. Included was the recommen-

dation that greater emphasis be given to "soft" and renewable energy options (solar, biomass, etc.). (b) The most debated issue of the Conference plenary sessions was a recommendation for a "moratorium on the construction of all new nuclear plants" for five years, for the purpose of encouraging "wider participation in a public debate on the risks, costs, and benefits of nuclear energy in all countries directly concerned," and a recommendation against the reprocessing of nuclear fuels in order to construct plutonium fuelled reactors because of the danger of weapons proliferation and other risks of plutonium (2:102). The rationale behind such a moratorium is discussed in detail in the report of the energy section (see Vol. 2, pp. 97-98) while the counter opinion of a minority is found on page 104. While recommending the moratorium the Section VI also said, "For the long term we believe that no options should be excluded *per se*, but for the short and medium terms we make a strong plea for a major shift toward the development of an effective implementation of the huge, as yet untapped, potential of the soft option" (2:96). For that reason we have printed a transcript of the floor debate on the Moratorium and the full report of the recommendations of the Conference. It is available upon request from Church and Society.

5. No summary can do justice to the high interest and feelings in the debate. The debate shows that some who supported the moratorium rejected nuclear energy and supported the moratorium only as a compromise.

6. The final plenary vote on the moratorium was 129 for the proposal, 45 against, 21 abstaining. The vote on the recommendation against reprocessing of nuclear fuels was 76 for, 32 against, 14 abstaining.

7. Most of the Conference recommendations have won widespread approval. However, the responses on the specific recommendations on the moratorium and reprocessing of nuclear fuels are diverse, reflecting the variety of national and regional situations, as well as differences of opinion within some nations. Some responses wish that the Conference had gone further, taking an anti-nuclear position. Other responses say that the Conference went too far. A different response says that the specific terms of the moratorium are unjust, because they allow nations with nuclear reactors under construction to enlarge their nuclear capacity, while denying nuclear energy entirely to other nations. Still other responses say that the recommendation is irrelevant or futile in their national situation. The discussion of the moratorium is continuing.

8. In the year since the Conference the controversy over nuclear energy has continued and increased in some sectors. There is every indication that it will continue into the future. Moratoria have been specifically adopted or accepted *de facto;* e.g. U.S.A., F.R.G., Netherlands and Austria. There have been widespread and very interesting forms of public participation in discussion of this issue, probably with broader public involvement than on any other recent issue of this sort. Votes and referenda have been held or are planned in a number of nations.

Recommendation III

That the Central Committee ask the member churches of the WCC to study all the recommendations on energy of the Conference at MIT, including the recommendations on the moratorium. These recommendations propose guidelines for churches, governments and individuals on responsible activity in relation to energy. We recommend that the Central Committee urge churches to encourage a debate in all countries and to discover for themselves the most effective ways to implement these recommendations in their own activities.

Recommendation IV

That as a follow-up to the national debates Church and Society should provide a written assessment of the public debates which have taken place on the risks, costs and benefits of nuclear energy and that this assessment should be communicated to the Central Committee in 1981.

B. *Energy for my Neighbour*

9. The Energy for my Neighbour Programme was adopted by the WCC in 1977 as a means of demonstrating in a practical way, at the level of the local churches, the concern for a just, participatory and sustainable effort between rich and poor countries. At the heart of the programme was conservation of energy in the affluent countries, with the financial savings transferred for the development and introduction of appropriate technologies in the less industrialized countries. Some projects were carried through, until staff limitations required suspension of such activities. The detailed mechanism of the programme is spelled out in the booklet, "Energy for my Neighbour: An Action Programme of the World Council of Churches." The 1979 Conference endorsed the ENP and recommended a "Fuel Pledge" as part of that programme. But it emphasized that the primary purpose of the ENP is to make all people aware that it is possible and necessary to be responsible in the acquiring and consuming of energy resources.

Recommendation V

That the Energy for my Neighbour Programme sponsor three or possibly four consultations, during the next two years, on the subject, "Just Energy Policies for Sustainable Societies," in the developing countries, one each in Asia, Africa, Latin America and possibly in the Middle East. The purpose of the consultations would be to actively involve churches and the public in Low Energy Use Countries in work on the role of energy in the development of these countries, with special emphasis on the following problems: (a) rural energy supplies, (b) large central energy sources, (c) ecological considerations, (d) considerations of political and economic justice.

Recommendation VI

That the Central Committee request Church and Society to participate, in whatever ways prove practical, in the U.N. Conference on New and Renewable Energy Sources (Nairobi, August, 1981).

III. SCIENCE FOR PEACE

1. Nuclear weapons were not on the original Conference agenda at MIT; it was a mounting sense of the threat they represented which led the Conference to set aside time to declare the urgent need for nuclear disarmament. Evidence was presented pointing to the new dangers created by increased deployment of small nuclear warheads, by technical improvements in range, accuracy and strength, and above all by the repeated attempts of the Super-Powers to match and surpass each other's developments. Convinced that a responsibility lay on scientists and on the Churches to stir world opinion out of its fatalism about nuclear war, the Conference passed the Resolution on nuclear disarmament (Vol. 2:169-170).

2. Since the Conference the urgency of the situation has increased. There has been rapid deterioration in relations between the United States and the Soviet Union, notably in the Middle East and South West Asia. The Super-Powers have failed in their attempts to ratify a significant nuclear arms limitation treaty. Decisions have been taken concerning the deployment of a new generation of nuclear weapons in Europe, and both Super-Powers have moved to the adoption of 'counter-force' weapons increasing the danger of first-strike pre-emptive war. The spread of nuclear weapons to other states has continued. As the January 1980 editorial in the *Bulletin of the Atomic Scientists* indicates, many scientists believe that in the past year the hands of the clock have moved closer to the midnight of nuclear war. One world leader has recently been moved to warn of the danger of the world sliding involuntarily into war. Nothing less than human survival is at stake.

3. If the world is to withdraw from the brink, a fresh impetus to nuclear disarmament is needed. Governments are responsible for maintaining the security of their nations, yet, as the final document of the 1979 U.N. Special Session on Disarmament declared, nuclear weapons have become 'much more a threat than a protection' for humanity. Can the Super-Powers agree on an immediate freeze on the deployment of the latest generation of weapons, as a way of halting the nuclear arms race in its tracks? Such an action would lay a solid base for them to restart the procedures for negotiated arms limitation and reduction; it would also make more likely progress with non-proliferation, since the non-nuclear states have repeatedly called for arms reductions by the nuclear states as an intrinsic element in non-proliferation. We are alarmed at the prospect of Third World resources, in particular, being diverted from the task of meeting the fundamental needs of those countries to the development of nuclear arms; but the nuclear powers cannot without hypocrisy oppose horizontal proliferation while they continue on their present policies of further weapons acquisition and improvement.

4. The main thrusts of the Conference's Science for Peace Resolution are still valid and should be pursued, though events have overtaken some elements of it. The work of the Commission of the Churches on International Affairs (CCIA) on the Programme on Disarmament in particular is of major importance. The great danger in which we now find ourselves calls however for a more striking style and a higher visibility to the programme. This new effort should include a direct approach by the WCC and the member churches to the leaders of the nuclear powers; action to inform the people of the world of the facts of the present crisis, and a specific appeal to members of the scientific community to recognize their own responsibility for the continuation of the nuclear arms race and act to challenge the current trends.

5. We therefore propose that the Central Committee at its August 1980 session make a public statement on the urgent need to halt the nuclear arms race by an immediate moratorium on the production, testing and deployment of all new nuclear weapons systems.

6. We additionally propose to the Central Committee that it accept or assign responsibility for

(a) convening an international Public Hearing at some neutral site on the current threat to world peace, with a special focus on the increased danger of nuclear war, and be able to cross-examine authoritative witnesses to provide detailed assessments of the prevailing trend toward a major East-West confrontation;

(b) encouraging church leaders to make contact with the political leaders of the nuclear powers and to urge upon them the need for immediate and imaginative steps to freeze the nuclear arms build-up while pursuing longer-term disarmament objectives;

(c) setting up a panel of leading scientists, government leaders, military experts committed to peace, and religious leaders to advise the WCC and the churches regarding the promotion of an appeal for an end to the nuclear arms race;

(d) encouraging approaches to bodies representative of the scientific community, its learned societies and institutions at international and national levels, to further discussion of the nuclear threat to peace and the role of science in bringing it to an end;

(e) contributing to broad public education throughout the world regarding the present danger of nuclear war (Vol. 2, p. 170), for example, by producing a brief study guide and other materials for use in the churches;

(f) mobilizing the member churches to alert people in their countries to the urgency of the threat of nuclear war and to launch priority programmes of church action in opposition to the nuclear arms race;

(g) inaugurating a World Day of Prayer and Action in opposition to nuclear war in cooperation with other religious bodies.

7. We call for extraordinary action, on an emergency basis. We envisage the need for the Central Committee to set up coordinating machinery to ensure that the resources of the WCC are effectively deployed to stimulate the public conscience on this matter. In addition to CCIA and other concerned sub-units, the resources of Church and Society should be drawn upon, in view of its contacts with the scientific community and its significant work on issues of science and technology. Such machinery should take account of the implications of this issue for the Third World. Consideration should be given to an approach to member churches, as well as to other churches and agencies, for support and resources.

IV. ETHICAL ISSUES IN THE BIOLOGICAL MANIPULATION OF LIFE

1. The Conference at MIT considered a broad range of ethical problems relating to developments in the biological and biomedical sciences, including (1) Eugenics (2:49); (2) Genetic Engineering (of bacteria, animals and humans (2:52)); (3) Behavioral Control (2:56); (4) Distribution of Scarce Medical Resources (2:62); (5) Experimentation on Humans and other Vertebrates (2:65).

2. A central theme that ran through the Conference discussion was the need to insure the preservation and enhancement of human dignity and potential in the development and application of these technologies, and the churches' special responsibility in this task. In summarizing the report we have emphasized the rapidly emerging technologies of genetic modification (recombinant DNA technology). These present certain new issues and sharpen many of the ethical issues associated with these and other medical and biological manipulations of life. We have also included some concerns which have emerged since the Conference about the ways such bio-technologies are being used in agriculture.

3. As the Conference plenary presentations and the Report on the Biological Manipulation of Life made clear recent advances in biological and medical technologies now permit the direct manipulation of genes—the blue-prints of living organisms. Segments of the genetic material—DNA molecules—can be taken from one organism and incorporated into the genetic material of an unrelated organism. Such genetic modifications may alter essential characteristics and properties of the organism, and may be transmitted to subsequent generations. These technologies have been developed as tools of biomedical research, and have readily spread through the research community, leading to major advances in knowledge of genetic and cellular processes in animals and plants. However, they are now being utilized in commercial production processes and applied medical technologies. This generates both new possibilities and new problems for human societies, in developed and developing countries.

4. The Conference Report emphasized the urgent need for ethical judgment and action in regard to these developments:

> "It is a fact of life that genetic engineering of micro-organisms, plants and animals, including humans, is under way. It is moving at a pace which far exceeds the expectations of even a year ago. The public must be informed of all that is now going on and planned so that it can anticipate the hazards and the unethical uses of this new technology before it is too late. Unless this is done, we may be confronted with a genetic holocaust. There is urgent need now to distinguish what is ethically acceptable and what is ethically unacceptable so that where constraints on the new technology are needed they can be imposed in time. The matter is of such urgency that it requires a much deeper analysis than is possible in this report" (2:53).

The Working Committee suggests that particular attention be given to the following areas discussed by the Conference.

A. *Agriculture and Emerging Biotechnology*

5. Though plants and animals have been selectively bred for thousands of years, the new technologies, which permit direct genetic modification of plant and animal cells, and the construction of unusual hybrid organisms, will vastly increase the rate of these processes. (Scientists present at the Working Committee in Stuttgart brought to its attention some of the implications of the new biotechnologies for agriculture which had not been dealt with by the Conference and which also deserve investigation. The just and equitable development of these technologies holds the prospect of improved food production, and of more sustainable energy generation. Unfortunately, the genetic modification of micro-organisms to perform useful functions is taking place increasingly under the auspices of corporations which will patent and therefore own the resulting organisms.* In addition, existing seed stocks of the world's food plants are being rapidly bought up by agrichemical and pharmaceutical transnationals. These corporations have pushed legislation in Europe and the USA to allow the private patenting of food plants and other organisms. To protect these patents they have also begun a campaign to suppress the growth and possession of natural varieties (which cannot be patented) thus endangering the world diversity of agriculturally important plants. This narrow control of the earth's plant and animal genetic resources may become a major impediment in the efforts of the developing countries to increase their food supply without coming under the dominance of the transnationals.)

* The U.S. Supreme Court has since decided in favour of the right to patent living organisms (*International Herald Tribune*, June 17, 1980).

B. *Microbial Production Processes*

6. Genetically modified bacteria, yeast and other micro-organisms will be useful for the production of proteins needed in the medical, pharmaceutical and chemical engineering fields. For example, one corporation is preparing to manufacture insulin for use by diabetics, using bacteria in which the human gene for insulin has been transplanted. Others are planning to manufacture human brain hormones, for research use, but also for anticipated future sales as mind and behavior modifying substances.

7. One particular problem associated with the new technologies is that the modified organisms may constitute an additional health hazard to the worker in these industries or to surrounding communities. A few countries have guidelines of varying degrees of precaution to prevent this, whereas in other countries the new industries are unregulated.

8. The life-altering nature of the technology, the self-reproducing nature of the potential pollution, and the private ownership of the organisms, raise serious social and ethical questions. The ability to introduce genetic material from a great variety of different organisms into bacteria and fungi has sharply increased the possibilities of developing micro-organisms for bacteriological warfare directed against humans and crop plants. A much higher level of public participation in decision-making processes will be required for the just development of these technologies.

C. *Human Genetics*

9. The Conference Report points out that the same technology developed to analyze and alter the DNA composition of micro-organisms is now available for direct analysis of the DNA molecules of human cells. This technology is being developed in the advanced medical sector to identify individuals and groups who carry genetic variations which may affect their health. It will greatly expand problems associated with genetic screening procedures which have up to now been limited to gross chromosomal abnormalities, or well defined biochemical disorders. Among these problems are questions of abortion of foetuses identified as "defective," a term which itself involves value judgments open to question.

10. There are other areas of medical genetics in addition to genetic engineering which pose direct and potential threats, and which give rise to concern. The Conference Report notes that such techniques as ovum transplantation, artificial insemination by donors and in-vitro fertilization are open to misuse and abuse, and challenge our basic views on the nature and meaning of human life.

11. Medical genetic technologies are presently in use mainly in the developed countries. Such advanced procedures tend to serve the needs of small groups of individuals rather than populations. Introduction of these technologies into the developing countries may exacerbate their lack of general health care.

12. In discussing this we must bear in mind that the primary aim of medicine should be to *prevent* disease. This requires a focus on those agents which damage the genetic material and therefore *cause* additional genetic diseases. A major effort must be mounted to utilize genetic technologies to identify, remove or restrict such mutagenic and carcinogenic agents from the human environment.

13. In the area of genetics, history has taught us that new developments can quickly and subtly be misused, usually affecting underprivileged and disenfranchised sectors of the population. The sterilization of blacks in the United States and the destruction of European Jewry under Fascism are painful examples of the misuse of genetic arguments to support false theories of racial inferiority. The thin borderline between beneficial and harmful use of medical genetics was particularly evident when groups of people were screened for genetic markers and then the affected individuals became stigmatized as somehow "defective" or "inferior."

14. The application of genetic techniques to identify genetic differences between individuals and groups raises many ethical, theological, social and legal problems. For example, who will decide what constitutes a difference, and what a defect? Continued vigilance is required to insure that genetic screening programmes are only applied in cases where the affected individuals can be helped.

15. The Working Committee noted with concern the use of genetic screening programmes by employers to identify "susceptible" individuals in hazardous work (for example, lead poisoning) and remove them from the job. The priority must be to make work safe for all.

16. The possibility of altering the genes of individuals, and in particular the genes of the germ line raise further difficulties, since future generations are affected. Because of the broader implications of the use of human genetic engineering, these decisions must take place in a much broader social context than conventional medical ethics. They cannot be only the products of a contract between biomedical scientists and subjects. The transplantation of DNA into the cells of humans is technically linked with recent advances in *reproductive technology,* such as in-vitro fertilization. All this work involves experimentation with human ova and sperm, embryos and individuals, and requires strictest observance of informed consent, and the protection of underprivileged groups. Appropriate principles are laid down in the Nuremberg Code.

D. *Behaviour Modification*

17. The Conference was concerned over the misuse of behaviour-altering chemicals and of techniques such as electric shock and psycho-surgery, particularly with individuals in relatively powerless situations, such as those in mental hospitals and prisons and poor and underprivileged groups. A less obvious but far more widespread form of behaviour modification is the large-scale marketing of behaviour-altering drugs such as tranqui-

lizers and anti-depressants by pharmaceutical corporations. These do nothing to alleviate the root causes of human suffering, and may induce a physiological or psychological dependency and an economical drain.

18. The Conference was concerned about certain theories of human personality and behaviour, some of which are associated with the term "socio-biology" which view human personality and character as the sum of our genetic determinants. These theories deny the maturing, interacting nature of humans in society, central to our ability to change the material, cultural and spiritual environments permitting greater fulfillment of human potential.

E. *Public Health and Scarce Medical Resources*

19. Most of the world's peoples still lack the basic conditions of nutrition, housing, sanitation and the medical care needed for the maintenance of health. In considering problems of medical technology the Conference concluded that the primary focus should be planning for and establishing systems of health care that serve all the citizens of a country, and not only the needs of a privileged few. Where maldistribution currently exists emphasis should be on redistribution and on preventive medicine. The Conference commended the WCC and its Christian Medical Commission for "excellent work on justice in the distribution of scarce medical resources and on other health care problems." Individuals, local Christian communities, national church councils and the WCC were urged to continue to make this matter of urgent concern.

Recommendation VII

20. That the WCC ask Church and Society to establish a Working Group on Biological Manipulation to observe and address developments in genetic and biochemical manipulation, reflecting the churches' concern in this area. The group should consist of at least 40 percent women and include citizens and union representatives, medical public health and scientific personnel as well as church representatives of differing theological traditions.

The following should be included in the Group's agenda:

(a) To contribute to the formulations of social and ethical principles to serve as guides in experimentation with genetic and reproductive technologies, such as human in-vitro fertilization.
(b) To encourage research on the identification of hazards to the human genetic constitution, such as mutagens and carcinogens, and the development of programmes to prevent exposure to these agents, such as pesticide exposure in both the industrialized and non-industrialized countries, including the socialist nations.
(c) To encourage the development of treatment for identified genetic disorders.
(d) To oppose and discourage any compulsory prenatal diagnosis or genetic screening.
(e) To investigate the threatening social and environmental consequences of the patenting of food plants and other life forms.
(f) To encourage the establishing and implementing of international guidelines for the use of recombinant DNA technology.
(g) To prepare literature for education on these technologies and their health hazards.
(h) To encourage the formation of local groups, broadly constituted to work toward policies for the employment of these technologies, and for setting priorities for further technological development in the area of biological manipulation.
(i) To initiate consultations with international law scholars, ethicists and geneticists to explore the drafting of a resolution towards a universal declaration of human rights in the area of genetic intervention on human beings. This declaration would be submitted to the Central Committee of the World Council of Churches for its consideration and reactions from the churches, following which the Central Committee might consider submission of the resolution to the appropriate body at the United Nations.

Recommendation VIII

21. That the WCC calls a consultation on "Behaviour Control and the Quality of Life," with special reference to the points noted in the Conference Report (2:66).

Recommendation IX

22. The WCC Group on Transnational Corporations should be asked

(a) to investigate the deleterious effects on health of the activities of pharmaceutical transnationals;
(b) to include in its investigations the prospect that transnationals will move the site of their biotechnology operations to countries where there are few, if any, restrictions on such technologies especially in the developing countries.

Recommendation X

23. That the Central Committee strongly reasserts its opposition to all forms of biological warfare, including those directed against food sources.

24. All other recommendations not listed here but contained in the Conference Report on Biological Manipulation remaining valid should be studied carefully and be put on the agenda as the Working Group on Biological Manipulation may decide.

V. THE POLITICAL, ECONOMIC AND TECHNOLOGICAL IMPLICATION OF SUSTAINABILITY FOR THE JUST, PARTICIPATORY AND SUSTAINABLE SOCIETY

A. *Social Justice and Sustainability*

1. The Conference at MIT accepted ecological and technological sustainability as a necessary, though not sufficient condition, for the existence of social justice (2:127). Yet it recognized that present political economic goals in most, if not all, countries constitute a trend toward grave unsustainability and therefore undermine the efforts to promote justice. (Since the Conference, the Report of the Brandt Commission (*North-South: Programme for Survival*) has stated: "We have a chance, if we are determined to do so, to shape the world's future in peace and welfare, in solidarity and dignity" (Brandt, p. 7). However, our Working Committee believes that more extensive changes are needed than the Brandt Report proposes if there is to be a transition to a more sustainable and just global society. Changes are required both in the economic and political models of capitalist and socialist countries and in the way in which science and technology are practiced in them.)

2. As the findings of the 1979 Conference make clear (especially in the report of Section V on "Technology, Resources, Environment and Population"), if all the world were to use the resources of water, minerals and fossil fuels at the rate at which the rich world uses them the known accessible reserves would be used up within less than a decade (2:76). All other kinds of resources needed for human survival derive from four basic biological systems: croplands, pastures, forests and fisheries. These are all under stress with the expansion of world population and the insistence of the rich countries on maintaining their present standard of living. The situation is critical: "Without a radical departure from the historical and contemporary record there will be little of all life forms for future generations to inherit. *Unlike the energy crisis, there are no alternative possibilities if the soil, water, grass, fish and forest resources become exhausted*" (2:74-5).

(Data published since the Conference indicate that the global productivity of all four systems may be in decline. The gravest decline is in tropical forests. According to the World Watch Report (1978) ten hectares of forest disappear from the earth every minute. This is the difference between what is removed and what is planted. These trends are indications of the unsustainability of each of these resources in the way they are managed. This ecological unsustainability is a world-wide phenomenon. However, a decline in productivity would be most serious for the developing countries whose populations are increasing much faster than those of the developed countries. It would be serious too for the rich countries which are utterly dependent upon these systems of production as they seek to maintain their present standard of living. The causes of such a fall in productivity are yet to be fully analyzed, but they include excessive consumption in relation to the capacity of the systems to sustain high rates of cropping, high inputs of energy and increasing environmental deterioration including pollution. According to the Organization for Economic Cooperation and Development Report, "Environmental Policies for the 1980's" (1980, pp. 30-31), between 1978 and 1985 certain types of pollution associated with agriculture, in the absence of changed patterns of demand use, will increase by as much as 50 percent. The corresponding figure for industrial pollution emissions is an increase of 10 to 25 percent.)

3. Any change in direction of these trends will be dependent upon changes in (i) the sort of science and technology practiced and (ii) the political economy which dictates these practices (2:160).

4. The Conference at MIT stressed the need to undertake a further inquiry into the need for and possibility of a new paradigm of political enonomy within which a transition to a more sustainable and more just society could be possible (2:125). Since the Zürich Consultation of 1978 the unsustainable and unjust nature of present practices has become more evident. There is now ever greater need to counter economic and political forces that either oppose sustainability or seek to achieve it without an equally strong concern for social justice.

B. *Science, Technology and Sustainability*

5. The effects of new science and technology depend largely upon the economic and political system within which they function. At present most of the dynamics of science and technology are directed toward the war machine and to increasing the quantity of consumer goods. Such production is not concerned with the needs of the community in which the goods are produced or the ecological systems on which the production is eventually dependent. This leads to (a) a huge waste of resources and therefore decreased sustainability, and (b) an increase in the power of the powerful, and therefore increased injustice.

6. The prime requirement of science and technology in the poor world is to produce by means appropriate to local circumstances goods for people in the poor world, not goods for people in the rich world. There will be an emphasis on both increase in production and increase in efficiency. There is much less need in the rich world for an increased production that feeds consumerism. But there is need for technology that improves efficiency and sustains the productive systems. Science and technology could, we believe, lead toward greater sustainability and justice rather than less, which is the present situation. But that will need a science and technology directed by a different political-economic paradigm than that which is dominant in the world today.

Recommendation XI

7. In view of the need for new Christian thinking about political economy from the standpoint of ecological

and technological sustainability the Working Committee recommends that Church and Society initiate a consultation on this subject. The consultation should include political economists concerned with the issue of sustainability, ecologists, industrial technologists and theologians from rich and poor countries and different social systems. Its brief would be:

i. to point the way to the nature of a political economy consistent with the requirements of sustainability, justice and participation and that would help people of different countries develop their own design of society consistent with these requirements (2:164-165).
ii. to develop a theology of work and gainful employment in response to the pressures created by the technologies of the computer and the micro-processor and to demonstrate that unemployment and underemployment are both unnecessary evils at the very time when so many socially needed tasks remain to be done (2:123). The full utilization of human resources should thus be recognized as an important goal particularly in the light of the impending crises in material and financial resources.
iii. to consider ways in which greater public participation can be obtained in the implementation of new technology by means of thorough public examination in order to counter the social and environmental costs of any indiscriminate application of new processes and new techniques.
iv. to prepare a booklet for distribution to the churches on the present state of unsustainability of the world's production systems, its relation to the dominant models of development and the need for a reorientation of science and technology within a new paradigm of poltical economy. A purpose of the booklet would be to arouse member churches to their critical responsibility within their own communities and countries to "replenish the earth" and promote justice before it is too late.

8. We consider this consultation a useful contribution of Church and Society to the wider ecumenical debate on the just, participatory and sustainable society including the work of the Commission on the Churches' Participation in Development (CCPD) Advisory Group on Economic Matters.

Recommendation XII

9. That the staff of Church and Society should, in cooperation with other staff concerned in the WCC, consider the possibility of updating the 1974 booklet on "Population and the Quality of Life" in the light of recommendations of the Report (2:86–87).

Recommendation XIII

10. That the WCC staff for the Transnational Corporation Study Project examine the proposal from the Conference (2:123) on the concept of ownership and management:

—the need to select production technologies which fulfill social goals of participation, sustainability and justice;
—the need to develop new forms of ownership and control of production technologies consistent with a larger time-scale of planning than that of most commercial organizations, operating on a world-wide basis.

VI. HUMANITY, NATURE AND GOD

1. Sections I and II of the Conference at MIT were especially concerned with conceptual and theoretical questions raised by the use and misuse of science and the dominance of the scientific world-view. The wide diversity of approach led to many interesting but inconclusive debates and much unfinished work. The Working Committee can only highlight some of the main points of this discussion.

A. *The Conceptual Crisis*

2. A view of reality supported by certain conceptions of science has for almost 300 years dominated industrial civilization. Today its influence is world-wide. The Conference Report states: "A mechanistic understanding of the natural (including human) world drawn from a hazy fusion of science and technology is becoming the dominant world-view of our time which all religions and philosophies have either to oppose or appropriate" (2:10).

3. Central to this dominance is "technical rationality" with its inescapable subject-object dichotomy and a bi-polar (humanity against nature) understanding of the universe which denies the dependence of all reality upon the Creator's will. Technical rationality has a one-dimensional and reductionist view of things, reducting all knowledge to what can be empirically tested or quantified. It thus cannot account for the wide range of human experience in art, culture and religion. Under these circumstances God becomes an unnecessary hypothesis. In the words of Section II of the Report, "God vanished from the view of modern science and humanity emerges as a substitute god over against nature" (2:29).

4. Although the world view of technical rationality remains generally dominant, "the developments in the history and philosophy of science, and indeed within science itself, have led them (scientists) to accept that their fundamental understanding of the natural world is not as absolutely certain as they had previously assumed" (2:9), and the inadequacies of technical rationality are producing a crisis of faith among many scientists. Consequently, scientists, historians and philosophers of science, along with others in the science-technology community are themselves engaged in a search

for new values and conceptions to guide the thinking and practice of science and technology.

Was the Conference Anti-Science?

5. The question today is how to evaluate the dominant "vision" behind human activity in science and technology, a vision to which the scientist and the technician consider themselves to be accountable? And how is that vision to be related to the "vision" of Christian faith regarding the destiny of humanity? Is the scientific vision derived from or in any other form clearly related to the Christian vision? If it is, how has that relationship developed over the centuries and why was the Christian vision apparently unable to keep the scientific vision within the framework of faith? What led to their estrangement and what distortions in both faith and science occurred as a result of this estrangement? The Report of Conference Section I inquires into these questions in a very preliminary way but it affirms the conviction that the spiritual renewal of science and the spiritual renewal of the Church have to be explored together.

6. Some have interpreted the Conference's critique of the scientific "vision" as a destructive attack on all scientific enterprise. But the Conference Report makes clear that in support of science it favours a critique of the parochial visions of faith as well as of science and technology in the interests of the "larger vision that deserves the respect of all people":

> "We have heard in this Conference a great deal of criticism of science because of its links with exploitative technological enterprises. We believe that the true and legitimate purpose of this critique is not to destroy science nor to violate its integrity. Rather the purpose . . . is to press home the conviction that unless science serves the purposes of love, it betrays its own vision and also the hopes of the world. This critique applies equally to the Church. In this sense, love and its corollary, the just, participatory and sustainable society, constitute the public criterion of verifiability and falsification. Our earlier discussion has concentrated on the internal sets of criteria applicable to science and faith, and these are essential. The chief and distinctive concern of this Conference is, however, this broader societal and exterior criterion" (2:20).

B. *The Challenge to Theology*

7. The crisis of the scientific-technological worldview presents an immense challenge to theology. In order to meet this challenge in an adequate way theology is compelled to renew its efforts to understand the relationship between God, humanity and nature. One of the focal points in the present theological debate is the Christian understanding of nature. In the Report of Section II the Conference proposes a fresh understanding of the biblical view of creation and redemption. It tries to interpret the concept of 'dominion' in the light of the concept of the *Imago Dei* which "indicates both humanity's relation to God and also the relation of humanity to the non-human creation" (2:30). And the Conference affirmed that the ecological crisis presses humanity to rediscover in the biblical tradition its partnership with nature and awe or wonder at the works of "the fingers of God."

8. The new approach thus opened up provides new opportunities for dialogue among different theologies and between scientific and theological thought.

9. The relation between scientific and theological understanding of the world has since the 17th century gone through various stages. Sometimes there has been a too easy rapproachement and at others, conflicts based on misunderstanding. At the Conference both scientists and theologians agreed that the present crisis created by the misuse of science and technology required new approaches to the science-faith relationship.

10. The Report on the Nature of Science and the Nature of Faith calls for a new dialogue between the two. It emphasizes that the urgent social and ethical questions posed by science and technology can only be adequately addressed if there is clarity about the underlying theological and philosophical issues. It calls attention to some key differences between the nature of knowledge in science and in faith, to the fact that both science and faith are community enterprises, each with its own verification process, and to the way in which the two have affected each other historically.

11. However, the Report shows that there is as yet little consensus as to how the dialogue should proceed. A chief difficulty is that dialogue demands a shared set of terms and clearly defined concepts. The lack of these hampered the discussion at the Conference and suggests necessary work yet to be done, if the faith-science-ethics dialogue is to progress.

C. *Dialogue with Other Faiths and Ideologies*

12. The Conference Report emphasizes that to have integrity the science-faith discussion must be enlarged to include other faiths and ideologies. This expanded discussion could help to clarify the specifically Christian element of the science-faith relationship. The Working Committee strongly supports the proposals of the Conference for expanding the WCC conversations and discussions with other faiths by inter-faith work on the issues of science and technology.

D. *Theology and Ethics*

13. The Conference recognized (especially in the Report of Section X) that any Christian approach to science and technology, and the ethical convictions we bring to bear upon it, must be consonant with our faith and our hope in Jesus Christ and in the Holy Trinity. This faith has found varying theological expressions in different cultures and traditions. In spite of the fact that people start from these varying theologies it has proved possible to arrive at a consensus on important ethical imperatives like justice, the elimination of poverty and protection of the environment; but the temptation should

be resisted to rest content with the ethical consensus and to ignore the underlying theological bases which are often controversial. The ethical questions posed by nuclear energy, the biological manipulation of life, and the just distribution of scientific-technological power raise profound questions about the meaning and purpose of life, of being human, about the unity of humanity, and the understanding of love in community. All of these questions call for substantial theological reflection and cannot be resolved at an ethical level alone.

14. Similarly, a consensus among various religions and ideologies on the ethical issues relating to science and technology is not only possible, but necessary if they are to act together in a plural society. A better understanding of the various schools of religious or secular thought can bring new illumination. But here again, it would be an illusion to allow the common social-ethical concern to obscure fundamental differences about human nature and destiny.

In light of the desires expressed by participants in the Conference at MIT the Working Committee recommended:

Recommendation XIV

That Church and Society organize, in cooperation with Faith and Order and other appropriate sub-units, a study seminar of theologians, with some natural and social scientists and historians and philosophers of science. The purpose would be to pursue the discussion begun at MIT and previous consultations.

Recommendation XV

That Church and Society organize, in cooperation with the sub-unit on Dialogue with People of other Faiths and Ideologies (DFI), a consultation in Asia of religious thinkers, philosophers and historians of science as well as social and natural scientists, from the great Asian religions, to pursue further the dialogue begun at the Conference at MIT on the vision of reality and the approach to science/technology in different traditions.

Recommendation XVI

We have become deeply aware in our work on science and technology, especially at the MIT Conference, of the need for a thorough study of the theological basis of Christian social ethics and its implications for the ethical problems that arise from science and technology today. We recommend that the study include theologians, natural scientists, social scientists and possible victims of atomic explosions, industrial pollution and accidents, and improperly tested pharmaceutical drugs (2:147-165).

VII. SCIENCE EDUCATION

1. The dynamic characteristics of science and technology imply that the definition and implementation of a socially responsible scientific education is an unending task. The education of the scientist, the science student and the public is never complete, because new discovery and innovation change both the content and context of scientific knowledge.

2. In recent years it has become widely accepted, though insufficiently implemented, that both the early training and the continuing education of the scientist must include the study of ethical responsibilities for persons and for society. It is particularly urgent that men and women of all walks of life should be made aware of those advances in science and technology which offer opportunities or hazards, promises or threats.

3. Only a public which understands the capabilities and limitations of science will be able to demand appropriate science and technology. Only scientists who have been sensitized to its ethical discussion will be able to respond to such public demands. Both of these conditions can be met when scientists and non-scientists meet together. The Conference at MIT considered that local and national churches are often well situated to facilitate such mutual education and should grasp such opportunities when they arise (2:165).

4. However, clergy and theologians are frequently insufficiently equipped to face the ethical challenges posed by new technological and scientific developments. Moreover, the issues of science and technology and of public participation in increasingly complex technological societies have been widely neglected in the curricula of theological education. The Conference stressed the potential role of seminaries and theological schools as places where there can be "continued discussion and interaction among scientists, theologians and lay people on the ethical aspects of the growing influence of science and technology on our societies" (2:165).

5. There already exists, especially in many developed countries, a considerable amount of expertise in the communication of science and ethics at a fairly sophisticated level to a relatively small audience. It is important that such communication be extended to mass audiences in all countries so that a careful and sensitive handling of scientific and ethical issues may be introduced into popular television and radio programmes. Such widespread dissemination is essential to improve public understanding of such matters and to make possible public participation in decision-making.

The Role of Students

6. The discussion of the nature of science education will be incomplete without the active participation of students. This was well exemplified by the influence of students on the dynamics of the Conference at MIT. Students are particularly concerned with the processes of scientific education for Third World peoples both in their own countries and when their students come to developed countries for study.

7. A major concern of students and others about scientific education is that it fails to provide an adequate process by which women can participate fully in the structure of science and technology.

The Working Committee recommends:

Recommendation XVII

That the sub-unit on Church and Society should collaborate with the Film and Visual Arts section of the WCC Department on Communication and with the World Association of Christian Communication to organize a 'Media Workshop' to explore ways in which the media are communicating issues of science and ethics, and how this might be improved and expanded to reach mass audiences. This would bring together professional communicators from all over the world, particularly producers, directors and programmers in radio and television. It is suggested that a 'Film Festival' model might be adopted whereby those who have already produced such programmes would exhibit and criticize examples of their work in collaboration with those involved in the mass communication field. This workshop could also help in the preparation of several short films on the ethical issues of science and technology for use in local churches.

Recommendation XVIII

That in all future WCC consultations on science and technology, a substantial number of science and technology students and other young people with experience related to the agenda of a particular consultation be invited and involved as full participants.

Recommendation XIX

That, as a pilot project, a regional follow-up meeting of science and technology students together with other interested young people be organized, possibly in Latin America, under the sponsorship of Church and Society and in cooperation with the WCC sub-unit on Youth and the World Student Christian Federation (WSCF). Possible themes for such a consultation were suggested by the Student Conference at Wellesley (2:182, Section 6) and the Conference at MIT (2:48, v).

Recommendation XX

That those responsible for implementing the "Science for Peace" resolution pay particular attention to the educational objectives listed (2:184, no. 3, and 2:47-48, iii, vi and ix), in order that an informed debate on these issues may take place.

Recommendation XXI

That in all follow-up conferences organized by the sub-unit on Church and Society, women should be substantially represented.

Recommendation XXII

That the WCC sub-unit on Women in Church and Society give particular attention to the recommendations coming from the Student Conference, viz.

a. ensuring justice in scientific and technical institutions which currently discriminate against women,
b. promoting the participation of women to positions of influence and power in decisions that affect the lives of all people,
c. working for educational systems which ensure that women, as well as men, can fulfill their total potential.

VIII. SUMMARY OF RECOMMENDATIONS AND WORK PLAN FOR THE FOLLOW-UP

The clue to a practical and successful follow-up of the 1979 Conference is to use the modest staff and financial resources of the sub-unit on Church and Society to stimulate and build upon the growing interest of lay persons and theologians in the issues of faith, science and society. The Working Committee envisages the following strategy:

A. Work with local and national churches and councils
B. A focus on needs and concerns of Third World peoples
C. Several international meetings and consultations to pursue ecumenical analysis and discussion of a limited number of critical issues.

Arranging the various recommendations in this report according to the above strategy leads to the following plan and work schedule.

A. *Work with Local and National Churches and Councils* (1980-1983)

The responsibility of the Geneva staff will be

(1) To make the Official Report and Recommendations of the Conference available to member churches, and interested study groups. This will involve the preparation of a study guide and index to the Official Conference Report to make it more useful in discussion in local churches.
(2) To secure the help of the WCC Communications Unit and the World Association of Christian Communication in preparing a film or films presenting the crucial ethical issues of science and technology in a vivid and interesting manner. (Recommendation XVII, p. 60)
(3) To make available follow-up literature (through *Anticipation* and by other means) which will feed into and strengthen the continuing discussion in the churches.

B. *Focus on the Needs and Concerns of Third World Countries*

The Geneva staff will be responsible in *1980 and 1981* for

(1) Three or four consultations on Energy Issues

in Third World regions and countries. (Recommendation V, p. 51, and also Recommendation VI)

(2) A series of meetings in Third World countries to mobilize both theological and scientific talent for the further discussion of critical issues. (Recommendation I, p. 50)

(3) Organizing, in cooperation with interested churches in the industrial and Third World countries, an expert Task Force to examine critically new developments in science and technology which are of particular importance to developing countries. (Recommendation II, p. 50)

(4) Convene a WCC consultation in Asia (in collaboration with DFI) on the Asian Religious Dialogue about Science and Technology.

(5) Regional follow-up meeting in Latin America with science students (in collaboration with the WCC Youth sub-unit and the WSCF). (Recommendation XIX, p. 60)

C. *International Meetings and Projects (1980-1981)*

Geneva staff will

(1) Prepare a written assessment of the public debates on nuclear energy for the Central Committee, 1981. (Recommendation IV, p. 51)

(2) Organize an International Working Group on Biological Manipulation to advise the churches on the ethical implications of such new technologies. (Recommendation VII, p. 55)

(3) Organize a study seminar on Critical Theological Issues in the Faith-Science debate (Recommendation XIV, p. 59), including a review of the theological basis of Christian social ethics in relation to the ethical problems of science and technology (Recommendation XVI, p. 59)

(4) Prepare a consultation on the new social, economic and technological thinking needed for the transition toward a Sustainable Society. (Recommendation XI, pp. 56, 57)

Note (1): Between January and July 1982 the staff would give primary attention to the preparation of a report to the 1983 Assembly based on the 1979 Conference, the response to it and the results of the follow-up programme.

Note (2): All other Recommendations in this report will be directly forwarded to the Central Committee or to appropriate WCC sub-units.

APPENDIX

List of Participants

Meeting of Working Committee on Church and Society

Stuttgart, FRG, May 27-June 2, 1980

Members of Working Committee

GREGORIOS, Metropolitan Paulos (Moderator)	Metropolitan of New Delhi, India
BIRCH, Prof. Charles (Vice-Moderator)	Challis Professor of Biology, University of Sydney, Australia
DUMAS, Prof. André	Professeur de Morale et Philosophie, Protestant Theological Faculty, Paris, France
KIM, Prof. Young Gul	Vice-President and Professor, Korea Advanced Institute of Science, Seoul, South Korea
de LANGE, Dr. H.M.	Director, University Institute for Value Research and Training, Rotterdam, Netherlands
MUSTAFIN, Archpriest Vladimir	Lecturer, Leningrad Theological Academy, U.S.S.R.
NASHED, Dr. W.N. (Egypt)	Industrial Management Training Adviser, U.N. Development Programme, Riyadh, Saudi Arabia
NUGENT, Dr. Randolph	Director, Board of Global Ministries, National Division, United Methodist Church, U.S.A.
NWOSU, Dr. B.C.E.	Chief Education Officer (Science), Federal Ministry of Education, Lagos, Nigeria
SELLER, Dr. Mary	Lecturer in Experimental Biology, Guy's Hospital, London, England
SCHOLZ, Dr. Günter	Plant Biochemist, Gatersleben, GDR

SHINN, Prof. Roger	Professor of Social Ethics, Union Theological Seminary, New York, U.S.A.
SIMIONESCU, Mr. Constantin	Architect, Bucarest, Romania
Substitutes	
HÜBNER, Prof. Dr. Jürgen (for Prof. Dr. Hans Schulze)	Scientific Consultant, Evangelical Church's Research Working Group, Heidelberg, FRG
WILLIAMS, Prof. G.R. (for Prof. James Ham)	Professor of Biochemistry, University of Toronto, Canada
Roman Catholic Observer-Participants	
MURPHY, Msgr. William	Under-Secretary for Pontifical Commission Justice and Peace, the Vatican
VEREB, Fr. Jerome-Michael	Attaché, Secretariat for Promoting Christian Unity, the Vatican
Consultants	
ALVES, Prof. Rubem	Professor of Philosophy, University of Campinas, Brazil
ECCLESTONE, Mr. G.S.	Secretary, Board for Social Responsibility, Church of England, London, England
FALCKE, Dr. Heino	Dean, Theological College, Erfurt, GDR
FRANCIS, Dr. John M.	Nuclear Scientist and Government Administrator, Edinburgh, U.K.
HAJJAR, Dr. Raja F.	Professor of Chemistry, Beirut University College, Lebanon
JENSEN, The Rev. Dr. Ole	Dean of the Cathedral, Maribo, Denmark
KING, Prof. Jonathan	Professor of Molecular Biology, MIT, Cambridge, U.S.A.
LEUENBERGER, Prof. Theodor	Professor of Contemporary Social and Economic History, University of St. Gallen, Switzerland
MENDELSOHN, Dr. Everett	Professor of the History and Philosophy of Science, Harvard University, Cambridge, U.S.A.
ORREGO, Dr. J. Cristian (Chile)	Postdoctoral Associate, Department of Biology, MIT, Cambridge, U.S.A.
PARSONAGE, Dr. Robert	Executive Secretary, Program on Education in Society, Division of Education in Society, Division of Education and Ministry, National Council of Churches, New York, U.S.A.
RENDTORFF, Prof. Dr. Trutz	Professor of Systematic Theology, University of Munich, FRG
SCHROEDER, Prof. Dr. Traute	Professor, Institute of Human Genetics, Heidelberg, FRG
Guest	
CLIFFORD, Dr. Paul R.	Director, Foundation for the Study of Christianity and Society, U.K.
Church and Society Staff	
ABRECHT, Dr. Paul	Director, Sub-unit on Church and Society
PASZTOR, Mr. Janos	Consultant for Programme—Energy for my Neighbour
STALSCHUS, Miss Christa	Administrative Assistant
SCHERHANS, Mr. Peter	Coopted Staff—Organizer of the Science Students' Conference
SCHULTZ, The Rev. Gordon	Secretary—North American Follow-up of the MIT Conference, Cambridge, U.S.A.
Other WCC Staff	
KOSHY, Mr. Ninan	Programme Secretary, Churches' Commission on International Affairs
de SANTA ANA, Dr. Julio (part-time)	Director, Commission on the Churches' Participation in Development.

Scientists in Society

Jonathan King

Dr. King is Professor of Molecular Biology at the Massachusetts Institute of Technology.

The WCC conference on Faith, Science and the Future held at MIT last July represented an important step in bridging the gap between those in the Church concerned about the impact of science and technology in human society, and those of us in the scientific and technical sphere who are worried about the uses and misuses of our labours. Since the gap between the Church and the scientific community is wide indeed, such bridges are critical for further communication.

During the period from the Reformation up until World War II, most scientific investigation was closely tied to the development of particular industrial processes; metallurgy with the need for better steel for boilers, blades and railroad track; geology with the search for fossil fuels; chemistry with the development of dyes for the textile industry and glazes for pottery. Though universities were centres of scientific activity, lack of funds always severely limited the scope and extent of scientific research.

World War II marked a transformation in the social organization of science and technology. During World War II thousands of physicists, biologists, chemists and engineers were integrated systematically into their government's war efforts. Though tragic that this came into being around human destruction, the organized endeavour was extraordinarily efficient. As a result we find in the industrial countries after World War II efforts to systematically develop and financially support the process of scientific and technical innovation.

In my own field for example, biomedical research, the U.S. national budget was some $3 million at the end of World War II.

However, over the next 30 years it increased over 1000 fold to the current level of $3 billion. Similar increases in national support occurred in physics, electronics, chemistry and the social sciences. This has fuelled new scientific revolutions in electronics with the growth of computers, and in biology with the development of genetic engineering technology.

Unfortunately the largest beneficiary and focus of this funding was for military and weapons research. Half of the scientists and engineers in the industrialized nations are employed in the development of more efficient means of human social and individual destruction. For example, the U.S. budget for military research and development is about $15 billion, more than all other forms of R & D combined, medical, environmental, energy, etc.

This economic and social support for scientific and technological development has increased the rate of technological innovation and application; many of these are socially productive and necessary: improved control of disease, electronic means of human communication, improved methods of agriculture.

However, there are major problems, long with us, but now of increasing severity.

Emerging problems

1. Scientific and technical innovation is now often developed at a rate that is faster than the rate at which they can be integrated into the fabric of society.

2. Many of these innovations are the product of very narrow social and economic interests—they were never designed for the benefit of the whole society. Often they have deleterious effects on large sectors of society, for example, the massive use of pesticides and herbicides in Third World nations, which poison farmworkers and the long-term productivity of the ecosystem, in order to increase the short-term profitability to the producer.

3. Modern technologies release or attempt to harness natural forces which are vast with respect to the scale of human activity. The energy of coal and steam harnessed by the steam engine to run the first power looms was greater than the muscle power of the individual weaver; yet it was still on the scale of groups of humans. But the forces released in splitting atoms are truly cosmic, they do not naturally occur on the face of the earth. A hydrogen weapon explosion is millions of times more powerful than chemical explosions; it is qualitatively different from previous weapons developments.

Similarly the new technologies of biological manipulation and genetic engineering have the power to bring about changes in organisms and in the ecosystem that previously would have taken tens of millions of years, if they occurred at all. We scientists can now fuse together the cells of a mouse with the cells of human, to form hybrid mouse/human cells. We can fuse together the genetic material—the blueprints of life—of an oak tree with the genetic material of a bacterium. The use of these technologies to modify human beings brings into

question the very notion of what it means to be human.

4. Most scientific and technical development is still undertaken in the industrialized nations, but major applications are made in Third World nations. There thorough investigations of the ecosystems, of the relationships of plants and animals to human habitation, have not been made. Furthermore, the education of the general population is often severely limited, so that when faced with, for example, the technical array of talent that a pharmaceutical transnational corporation can mobilize, they cannot participate in the shaping of the local uses of science and technology. Because of that lack of participation, the applications cannot be *scientific* (though it often will be efficiently exploitative) because fundamental information about the local ecosystem or society has been left out. This *exclusion* of the peoples of the Third World, as well as of poor and working people in the industrialized countries, *prevents* the use of knowledge for social benefit.

I would like to emphasize here that my own sensitivity about the Third World was the result of participating in the MIT conference. It was my first experience in working with people who were actually concerned over the plight of the world's peoples, and it was an invaluable experience.

Who shall science serve?

Scientific and technical resources are not unlimited; some areas of knowledge and application are developed, others are left in a primitive state. These decisions are determined by major social and economic forces: chemical companies that manufacture pesticides or drugs are not interested in supporting research on whether these chemicals are the cause of human kidney disease. The oil monopolies have a vested interest in the suppression of the technology of solar energy, unless it involves huge capital intensive projects that would stay in their ownership. A military/industrial complex profiting off the manufacture of ever more powerful nuclear bombs does not support research on how radiation damages our genes. Transnational corporations reaping their income off the exploitation of agricultural labour do not fight for universal education, or for research on forms of early education that encourage the fullest development of human potential. However, they may be quite happy to support sociobiological theories that argue for the intrinsic social inferiority of the poor and working classes of the population.

Without the nurture of these underdeveloped branches of scientific knowledge, it will not be possible to build a just, participatory and sustainable society.

We scientists cannot alone release ourselves from the economic and intellectual pressures of those who finance our work, or from the narrowness of social vision associated with reductionist approaches to problems. Within our realm the limits are well defined; keep your nose in the problem, push forward to its solution, publish, compete for funds to continue, don't mess around with the World Council of Churches or other social activists. Don't ask if there might be other solutions than bigger missiles or more potent pesticides.

In an environment where half the jobs for scientists and engineers are for weapons development, is it any surprise that innocent individuals will be drawn into this work? In fact such work is rarely identified as weapons research, just electronic guidance development, or properties of materials, or mathematics of shock waves. To keep larger questions from being asked, the training is kept intentionally narrow.

Those of us in the scientific community who are concerned that human talent be used to build the just, participatory and sustainable society cannot be left alone. We need help, and we need your help, the help of those concerned over human dignity, human equality, and human fulfilment.

On the other hand, the WCC will not be able to serve the causes of humanity if it does not grapple with the way in which the direction of science and technology transform the conditions of human life. This grappling will require time, it will require effort, and it will require a concrete programme. Though the Conference at MIT was a beginning, and though it may have been a large effort on the part of the WCC, in truth, it created only the slightest ripple in the consciousness of the thousands of scientists and engineers at MIT, scientists and engineers who supervise the expenditures of tens of millions of dollars on research, all under the eyes of the world's largest and most powerful corporations, and tied to the world's largest and most powerful military machine.

The WCC can help science serve humanity

The report from the Conference at MIT identifies a number of critical areas which require the joint study and action by the WCC together with members of scientific and technical community, along with practical proposals as to how to proceed. Let me emphasize four areas of concern:

1. To turn scientists and technologists away from using their talents in the service of new weapons of mass destruction; thereby to stop the development and production of further nuclear weapons; and to begin to reduce the existing stocks.

2. To prevent the decimation of vast areas of the world's natural resources, together with pollution of the remaining resources, by corporations or nations that cover their self-interest in the cloak of "technological progress."

3. To push for the development of scientific education in the Third World, and indeed among all the world's peoples, that they may build just and sustainable societies; and to struggle to imbue young scientists with the idea of knowledge for the preservation and fulfilment of human dignity and life, and of the nature that nourishes that life and makes it possible.

The fourth, the rapidly developing technologies of biological manipulation and genetic engineering, is an area of special interest to me. These technologies are going to transform agriculture, they are going to trans-

form manufacturing processes, with living organisms being the agent catalyzing chemical reactions and synthesizing products; and they make it possible to modify the genes of human beings.

For the applications in agriculture and production to be socially beneficial will require a level of democratic, humane and participatory control that is not now seen possible in the economic and social structures which I am most familiar with. For example, the U.S. Supreme Court has recently decided that corporations can patent —can privately own—species of organisms that they have genetically modified. This opens the way for the world's food plants to become private property. It is bad enough for food to be sold for private profit rather than to feed people, but for the very plants themselves, the source of the food, to be under monopoly control of a privileged few is a chilling vision.

I do not know what lies in the future with respect to human genetic manipulation. But this desperately needs attention. We cannot allow such profound penetrations into the human to be left to the whims of individuals, doctor-subject pairs, corporations, or scientific associations. The setting up of a working group on biological manipulation, as proposed in the Stuttgart Report, is an immense step in beginning to grapple with these troubling questions.

Preventing a nuclear holocaust

In speaking at MIT, I ended with a special appeal, that the conference not close without making the strongest possible statement against what most scientists consider the greatest danger facing humankind today—the threat of nuclear holocaust. As I wrote the above my government announced a new military policy based on the doctrine of First Strike, that is, of initiating a nuclear attack which would wipe out the adversary's retaliatory capacity. On the morning I typed this, the radio announced that the government was initiating a programme of providing special shelters for the leaders. They may survive; but at the expense of the destruction of the rest of the human race in the northern hemisphere.

Therefore, I too call your attention to the Science for Peace Recommendation in the summary report of the Conference at MIT. This requests extraordinary action from this conference. And I repeat, please do not leave Geneva without speaking out as strongly as you can of the need to stop the motion toward nuclear destruction, and setting up the mechanism to carry your call to every one of your churches. If we do not reverse this madness, there will be no possibility of building the Just, Sustainable and Participatory Society that we all desire.

Thank you for giving me this opportunity to address you.

The Future of Science and Technology: Concerns of the Third World

*Professor D. Enilo Ajakaiye**

* Professor Ajakaiye is Dean of the Faculty of Science of Ahmadu Bello University in Nigeria.

I am a newcomer to the organized ecumenical movement. It came as a great surprise to me to be invited to the WCC Conference at MIT. In fact, I accepted the invitation more out of sheer curiosity. My church didn't tell me about the Conference. The Christian Council of Nigeria didn't tell me about the Conference. My pastor didn't know about the Conference, so he couldn't tell me. Later on at the Conference in MIT, I was told that a fellow scientist in Nigeria sent my name to the organizers and they sent me an invitation. So I was invited to MIT! The ways of the Church are sometimes a little roundabout.

I mention this because we must face the fact that many of our churches in Nigeria (and perhaps in several other Third World countries) know little about the WCC. And they are therefore not yet prepared to take part in the many interesting programmes of the WCC. But this, my first ecumencial experience, has indeed opened my eyes to these interesting and very useful programmes and has also added a new dimension to my responsibil-

ities as a Christian and a scientist.

It has not only opened up *my* eyes. Some of my scientist friends in Northern Nigeria are intrigued by my experience at MIT. One of them who is a leading Nigerian engineer, a Muslim, saw the Report from MIT on my desk and asked if he could borrow it overnight, and the next day he asked me where he could get a copy. He said, "I didn't know you Christians were concerned about questions such as science and technology." An almost identical statement was made by another colleague —an atheist scientist—after reading the first 50 pages of the report! I don't know if my church is really concerned about science and technology. These are questions my church has not yet dealt with even though Nigerian communities are being overwhelmed by modern technology, whether in petroleum or mining or rapid industrial development.

Everyone in Nigeria is very much aware of the "good" aspects of science and technology. For example, it now takes some seven hours to get here from Kano in Nigeria thanks to jet planes; new drugs have been very effectively used to cure our tropical diseases, etc.; the use of fertilizers has led to improved agriculture and food production; better shelter (homes) is being built as a direct result of science and technology; humanity in general knows a "little" bit more about the earth and the universe than our forefathers—thanks to developments in space research; and in Nigeria we watched the Olympics in Moscow "live" via satellite, etc., and so one can continue with an almost endless list!

But there is another side to the coin. Rapid technological development also means waste and abuse of the environment. Some of our Nigerian rivers and lakes are polluted with oil spillages. Forests are fast disappearing. At least 30,000 tons of gas are flared daily due to technical and economic considerations. These all mean that the local people are not only being denied adequate supply of protein, good drinking water and food, healthy and scenic environments, but they also have to change their lifestyles or careers. Fishermen can longer go fishing, and arable farmlands are so scorched that farmers cannot till the land. In Nigeria, for example, environmental problems associated with oil exploration have led to a phenomenal increase in various diseases (loss of sight, etc.) in several villages located in the oil-producing areas.

Despite our great advances in science and technology a large proportion of the world's population still lives in terrible poverty and malnutrition. On the other hand a vast part of modern scientific and technological research is spent preparing new military weapons. Much of our attention at MIT was given to these ambiguities of science and technology, especially as they affect the countries of the so-called Third World. I offer you three propositions.

I. The Third World wants a new deal in the division of the world's resources of science and technology.

To our people science and technology offer the possibility of new life—but we also see it as power, power over people and nations, as the Church and Society Working Committee says in its report on the Conference. We also realize that political, economic and cultural independence go hand in hand with scientific and technological independence. We had some hard discussions on this point during the Conference at MIT and since I had a little part in that struggle I want to share with you some impressions of the outcome. If scientific and technological knowledge is indeed power, developing nations are demand a new distribution of that power.

Shortly after our Conference at MIT, UNESCO published a report which succinctly states the ethical challenge in the world distribution of science and technology. This report gives the following figures:

	Developing	*Developed*
No. of scientists	6%	94%
Expenditure	3%	97%
No. of scientists per million population	98	2579

Also in a recent talk on 4 March 1980 to the Board of Governors of the International Atomic Energy Agency, the 1979 Nobel Prize winner in physics, Dr. Abdus Salam, in his appeal to the international community—both of governments, scientists and UN agencies, said:

> "A world so divided between the haves and have nots of science and technology cannot endure; at present an International Centre for Theoretical Physics (with a budget of $1.8 million) is all that is internationally available for physics for 90 developing countries. Compare this with European joint projects involving physics alone, of one-half billion dollars annually. Compare this with the cost of one nuclear submarine—$1.7 billion. One thousand centres like Trieste could flourish for one year for one of these and at present there are two hundred and fifty nuclear submarines in the world's oceans. Somehow, somewhere a break must come."

There can obviously be no justice and there can be no peace as long as such an unjust division of the world's technological power and capacities exists. There is no solution yet in sight, whether under the auspices of the UN or any other auspices which promise to correct the disparity in this unjust distribution. That is why many of us from the Third World at MIT said in our declaration to the Conference: "We denounce the historical and current use of science and technology by industrialized and technically advanced societies to serve military and economic interests which have brought about great sufferings to the people of the Third World. This has been done in the guise of an ideology of objectivity and value-free pursuit of truth." We are not opposed to science but we are opposed to the sinister *use* of science.

II. The developing countries do not just want to be handed other people's technology, they want the op-

portunity and help in developing their own unique technological capacities.

The key to industrial progress is technology which is often accompanied by serious social and ethical problems. Dr. Sadosky from Argentina in his address to the Conference stated the dilemma facing developing countries as, "How can they undertake urgently needed scientific, technological and industrial development in the face of such a threat, yet how can they avoid continued dependence if they do not?" Dr. Odhiambo from Kenya also posed similar questions, "How to initiate and sustain developments while at the same time keeping the sociocultural fabric of African people. . . How to overcome technological dependence of LDC's. . . How can national scientific and technological capabilities in LDC's be promoted?"

A new approach is needed. Mere "transfer of technology" from "north to south" has failed deplorably as it has often been accompanied by the transfer of the consumer habits of the north with its deleterious effects and has also, among other things, ended in perpetuating dependence on foreign know-how, perpetuating economic domination, stifling the scientific initiatives and technical innovations of local scientists and technologists, etc. It was also based on the present unjust economic order in which the poorer nations provide "raw materials and manpower cheaply to others who are the owners of science, technology, industry and international commerce. These others sell their expertise and manufactured products at prices of their own choosing."

At the Conference, the need in developing countries to evolve a human-oriented, science-based development was clearly identified. The key solution of which is the rapid development of technology and know-how which is in harmony with the pressing needs and problems, culture and environment of the people living in developing countries. Since the needs and problems of developing countries are often radically different from those of technologically advanced countries, the solutions to these problems often require new or revolutionary ideas of science and technology which have obviously been developed under different cultural settings and environment. Dr. Odhiambo cited an example of the unique and indigenous mixed farming system of the Wakara people in Africa. This system of farming is regarded as technically sound, very highly productive and agronomically difficult to improve upon.

It would appear that in fields such as agriculture, most Third World countries could benefit from designing and developing "their own" agricultural machinery which can be bought, serviced and used by peasants in villages primarily on a mixed-cropping system. In many developing countries there is a wealth of indigenous technologies in fields of agriculture; medicine (psychiatry and traditional medicine, pottery, etc.) and all that is needed is that these technologies be rationalized and modernized for wider and more sustained production.

One can perhaps summarize by saying that in order to achieve a just, sustainable and participating society, developing countries would of necessity have to invest financially in:

1. Scientific and technological research in order to develop at an accelerated pace their technological capabilities directed at solving the most pressing needs and problems of their people. This would require modifications in the present-day educational system in developing countries such as improved science education policies with emphasis on secondary education and the training of technologists, training of negotiators and legislators knowledgeable about technology at tertiary level, training of scientists and engineers, also at tertiary levels where scientific and ethical considerations are interwoven.
2. Purchase some technology from the "north" at a fair price, and with all the technological know-how embodied in the invention, so that it could be carefully adapted to national needs.

III. The idea of a just and responsible use of science and technology has still to be worked out by our communities, scientists and technologists, bureaucrats, as well as social scientists, laymen, etc. The churches can and should make a substantial contribution to the thinking our communities.

They can help to point out to people that science and technology are just *tools* which, carefully used, can make the material tasks of people easier, or carelessly used, can increase human suffering. The *needs* and *welfare* of humanity should be uppermost when we consider the uses of science. For this we and our churches must respond to two questions:

(a) Does the Church understand there is a crisis? Assuming they understand there is a problem, I doubt whether they really appreciate the dimensions of the problem. My students are often bewildered by the scientific explanation of the physical things which undermine traditional beliefs. What is the Church doing to help students deal with this crisis? Do they understand the crisis of the conflict of traditional beliefs and scientific teaching? And if my students are having such problems, I just wonder what is happening to our village people faced with the realities of a world more and more dependent on technology.

(b) The second question concerns the development of a science policy which is based on human needs. For this we need (1) better integration between natural and social scientists; (2) co-operation between policy makers and scientists; (3) the involvement of groups such as the churches concerned about human welfare. For the churches to make a positive contribution to this problem, it will need the help of the scientists within their midst who can give them a larger understanding of the requirements of a humanly-based technology policy.

My plea to the WCC is that it itself comes to grips with the dimensions of this problem: the abuse of the powers of science and technology and the unjust distribution of that power. There is no more urgent task than for the WCC to use its resources, strength and influence to bring about these changes at every level.

Report on the Conference on Faith, Science and the Future

Metropolitan Paulos Gregorios

In presenting the official summary report and recommendations from the 1979 World Conference on Faith, Science and the Future, as prepared by the Working Committee on Church and Society in its Stuttgart meeting of May/June 1980, may I, as Moderator of the Conference and of the Working Committee, be permitted to make the following remarks to supplement what has already been stated by Professor Enilo Ajakaiye and Professor Jonathan King.

The full report in two volumes—entitled *Faith and Science in an Unjust World* is already in your hands. So is Document no. 10 which is a draft report from the Working Committee to this Central Committee, which will be revised in the light of the comments from this Committee, and published in the form of a study pamphlet—with discussion material added—for use in small groups in local situations.

I want to highlight six points about the Conference and the follow-up.

1. *The Question of Follow-up Competence in the Churches and Ecumenical Bodies*

In the year since the Conference local, national and regional ecumenical bodies generally appear to have some difficulty in dealing effectively with issues it raised, and this for two reasons: first, they often do not have staff persons or offices competent in these rather new fields; second, Christians who are competent on these issues are often in a somewhat marginal relationship with the churches. They have to be drawn into the church-sponsored discussion and this will be done only when the leadership of the churches acquires sufficient information and interest in the area of discussion. The follow-up process of the Conference, if properly handled, can draw a wide spectrum of Christians now on the fringes of the Church into a closer fellowship.

2. *Science for Peace*

The Science for Peace Resolution was not initiated by the organizers of the Conference. It came spontaneously from the floor of the conference which conceived of it as a major request for significant action by the WCC Central Committee itself. The World Council can render a major service to a humanity frightened and harassed by the threat of a nuclear war. The resolution demands "extraordinary action on an emergency basis," because the magnitude of the peril is unprecedented, and the conscience of humanity has to be aroused through "a more striking style and a higher visibility to the programme" (Document no. 10, p. 52). It calls for a "a direct approach by the WCC and the member churches to the leaders of the nuclear powers; action to inform the people of the world of the facts of the present crisis; a special appeal to members of the scientific community to recognize their own responsibility for the continuation of the arms race and to act to challenge the current trends." The Working Committee for Church and Society asks for (1) a public statement from the WCC Central Committee at this session, (2) the convening of an international public hearing where authoritative witnesses can be cross-examined in an effort to assess the present situation, (3) the setting up of a panel of leading scientists, statesmen, peace-minded military experts, and religious leaders to advise the WCC and the churches, (4) inauguration of a World Day of Prayer and Action to prevent nuclear war.

This is a *cri-de-coeur* from the Christian scientific community. I trust that this Central Committee will respond with equal sincerity and fervour as well as with wisdom.

3. *The Moratorium on the Further Use of Nuclear Power*

One of the most debated actions of the Conference, and certainly the most widely reported in the press, was the recommendation directed to national governments, to "immediately introduce a moratorium on the construction of all new nuclear power plants for a period of five years; the purpose of this moratorium is to encourage and enable wide participation in a public debate on the risks, costs and benefits of nuclear energy in all countries directly concerned." This action was and remains contorversial. Indeed our Working Committee had great trouble in agreeing on the two pages in Document no. 10 concerning the implications of the action taken. While

some believe that the position taken follows from earlier WCC Central Committee positions, others argue that it represents a decisive tilt away from considering nuclear fission as an option.

The first reactions in our churches to the proposal of a moratorium have been very diverse. But it has challenged more churches to take up this issue. The recommendation (page 51 of Document no. 10) of the Working Committee is in two parts: (a) that the churches be encouraged to study the Energy Report from the Conference and (b) that a report on these further deliberations be made to the Central Committee in 1981.

4. *Science, Technology and Sustainability*

What often masquerades as science, especially in the human sciences seems often to carry a large ideological content. Economics is the best example, sociology is another. What is taught as the science of economics in many of our academic institutions seems tuned to the ideological assumptions of the dominant group in society. The Conference was convinced of the need for new Christian thinking about political economy especially from the standpoint of ecological and technological sustainability, but it didn't get very far in its own debates. We faced the familiar impasse between economists from the poor countries who fear that the concern about sustainability will be used to keep their economies poor and the economists from the rich countries concerned about the growing pressure on world resources arising from the continuing emphasis on economic productivity. The Conference plenary debate on this issue between Prof. C.T. Kurien (India) and Prof. Herman Daly (USA) has been widely reported in the press. The Working Committee on Church and Society is convinced that the discussion and reflection on this point must continue and that a further follow-up encounter between economists and technologists of different viewpoints would be helpful. On pages 56 and 57 of Document no. 10 we outline the purpose of such an encounter.

5. *Emerging Theological Issues*

I have kept the theology to the end, not because it is less important but because, on the contrary, our Working Committee considers it the most important. Three sets of conceptual problems we regard as central to the issue of faith and life in a world shaped by science and technology:

a. *the nature of reality* and the relation between God, humanity and the rest of creation
b. *the nature of knowledge,* the ways of knowing reality—in science and in faith/worship
c. *the ways of changing reality* and the *nature of our Christian ethical responsibility.*

The first may be called the ontological question (or the question of being) and the second the epistemological question (or the question of how we know what is). Our cultures and civilizations are based on certain fundamental ontological and epistemological assumptions about the nature of reality and about the available ways of knowing and dealing with that reality. Please do not consider these theological questions too remote. They point to the stuff of which our common deepest beliefs about life is made, whether we be Christians or not, and they are the basis of our ethics. It is our hope that Church and Society and other sub-units—especially Faith and Order—will work together on these issues.

On the nature of reality—three positions seem to have emerged: a. the neo-reformed position, exemplified by theologians like Charles West and Gerhard Leidke—"a theology of solidarity in conflict between humanity and the natural world" qualified by a theology of responsible human stewardship of nature; b. the process-theology position exemplified by Charles Birch in which God, humanity and world are together in process of fulfillment in cosmic history; and c. the Eastern Orthodox theological position in which humanity stands between God and His creation, participating in both, and transfiguring the world to become a manifestation of the glory of God.

These are not three water-tight positions. There are many common elements. The WCC can help encourage the dialogue between these different positions, as a means to enlarge our understanding of their implications for the Christian mission today. The key questions are these:

1. What is the relation between humanity and the rest of creation? To what extent are they integral to each other, and to what extent to be distinguished? How does the redemption in Christ affect both?

2. How can the world have "secular autonomy" if its very existence is always contingent upon the word and will of God? What are the practical consequences of whatever answer we give to this question?

b. On the second major question—the epistemological one about the ways of knowing in science and faith, even more fundamental issues seem to be implied. Again three positions seem to emerge:

i. Science is capable of yielding all knowledge necessary for humanity, and there are no other reliable ways of knowing—this is the basic position of Marxism and some forms of western positivism and liberalism.

ii. Science deals with material reality; faith or religion deals with spiritual reality; each should be autonomous in its own realm and not interfere with the other; many Christians seem to be acting out of this position;

iii. The scientific way of knowing is a particular perception of reality created by a particular culture; its perceptions are operationally valid and useful, but neither totally objective nor fully proved; the regularities and predictabilities we find therein point to some reliable structure of truth in the order of creation, but we need the assistance of revelation to find ultimate meanings within it; nei-

ther scientific knowledge nor revealed understanding is perfect or final. Both in science and in faith, we see only through a glass, darkly.

Again we need to intensify dialogue between these three positions.

c. How do we see "the good" and change reality in accord with the good that we see? The third major set of questions seems to be the one so far least explored. No positions have emerged, since discussion has not proceeded that far. Only some questions for starting the discussion can be mentioned.

i. What is the relation between technological and political economic power, and spiritual power (e.g., the power of prayer to change reality, to heal, to love, etc.)? Is it possible to achieve some kind of balance between these two kinds of powers, or do we have to adjure the one to develop the other? Have the magnitude and newness of technological power so impressed us that we pay only lip-service to the other kind of power?

ii. What are the conditions for moving toward a civilization in which technological power is controlled by a just structure of political-economic power, and both by a widely diffused and non-dominant beneficent spiritual power? (i.e., not clericalized, centralized into an ethical, spiritual elite.)

iii. Is there a fourth kind of demonic power which literally bedevils all three levels of power—technological, political-economic and spiritual? How do we assess the nature of evil? How do we develop the power to fight against evil at all three levels, and to grow in the power of the good?

Mr. Moderator, these are tentative and clumsy formulations of some deep issues at the heart of our civilization and of the future of our existence as humanity. It is our hope that these questions will be highlighted at the next Assembly in Vancouver. If that is to be done, a lot of work will have to be done between now and the next Assembly.

6. *The Name of our Sub-Unit*

We are a bit troubled on account of the name of our sub-unit. Once upon a time, especially before Uppsala, 1968, we did deal with a very wide range of Church and Society issues. But then development-justice concerns found a separate portfolio in the Commission on the Churches' Participation in Development. Racism was taken up by the Program to Combat Racism. Our major concern became that of seeing the role of the Church in a civilization based on modern science and technology. That is what we have tried to do since 1968.

But people still expect us to take up all sorts of Church and Society issues, since that is the name of our sub-unit. Can you help us set the machinery moving to a name closer to what we are doing—like *Faith, Science and Society*, or more simply *Science and Society*? That would clarify our work and allow us to stave off the exorbitant demands on our very limited staff time.

Moderator, the reports of the MIT Conference and of the Working Committee on Church and Society are respectfully submitted to the Central Committee.

August 14, 1980

Actions of the WCC Central Committee on Church and Society

Geneva, Switzerland August 21, 1980

1. *The Central Committee received with appreciation the report of Church and Society and registered its warm response to the appeal to the Churches from two distinguished representatives from the scientific community* (Prof. Ajakaiye of Nigeria and Prof. King of the USA) who affirmed the need of help from the Churches in facing the ethical issues raised by science and technology.

2. *The Central Committee received with appreciation the Report of the World Conference at MIT, "Faith and Science in an Unjust World" (1980) and commended it to the Churches for their study and action.* The Central Committee noted that many member churches are already taking up the issues raised by the Conference and that the sub-unit on Church and Society would make periodic reports to Central Committee on the ongoing discussion in the Churches.

3. *The Central Committee received the report of the Working Committee on Church and Society* containing proposals for the follow-up of the Conference. *It*

endorsed the overall plan proposed in this report and the time-schedule outlined therein.

4. The Unit I Committee, having received the specific recommendations of the Working Committee Report *recommends to the Central Committee that Church and Society be encouraged to give priority to the following six themes:*

1. The World Debate about Energy Options.
2. Science for Peace.
3. Biological Manipulation of Life.
4. The Political-Economic and Technological Implications of Sustainability for the Just, Participatory and Sustainable Society (JPSS).
5. Theological Issues in Relation to Humanity, Nature and God.
6. Science Education.

5. *The Central Committee commends these concerns to the Churches with the following specific requests:*

5.1. *The World Debate about Energy Options*

a. The Central Committee endorses the call to the Heads of Governments by the WCC Conference on Faith, Science and the Future for an immediate five year moratorium on the construction of new nuclear power plants to enable the overall risks, costs and benefits of this energy option to be properly evaluated in public debate; and asks the member churches of the WCC to study all the recommendations on energy adopted by the Conference*;

b. the Central Committee urges Churches to encourage a debate in all countries and to discover for themselves the most effective ways to implement these recommendations in their own activities;

c. the Central Committee takes note of the series of consultations being planned in Third World countries on the theme: "Just Energy Policies for Sustainable Societies";

d. in the light of these discussions the Central Committee requests Church and Society to present an assessment of the energy debate to the Central Committee in 1981.

5.2. *Science for Peace*

The Central Committee urged Church and Society to cooperate with the proposed WCC international panel of experts in working on the following issues of science and disarmament:

a. the ways in which science and technology contribute to the arms race and the way in which the legitimate human purposes of science and technology are distorted by being in the service of militarism;

b. to explore ways in which the transition can be made from military use to peaceful use for the benefit of humanity;

c. the facts about the development of new weapons and their effects on national security and economic development;

d. the consequences of the use of nuclear weapons, whether for "limited" or all-out nuclear conflict;

e. the environmental, biological and social hazards of the production, storage and replacement of nuclear weapons.

Central Committee asked Church and Society to call specific attention in the churches to the section in the 1979 Conference Report on "Military Technology: Issues of Power and Peace."

5.3. *Biological Manipulation of Life*

The Central Committee approved the plan outlined in the Report of the Church and Society Working Committee (Document no. 10, see page 55) to establish an Advisory Group on Biological Manipulation of Life. The purpose is to advise the Churches on the ethical implications and social consequences of the rapid developments in genetic and biochemical manipulation.

5.4. *The Political-Economic and the Technological Implications of Sustainability for the JPSS*

The Central Committee approved the plans for a consultation on the social, economic and technological implications of the concern for sustainability within the overall ecumenical participation in the struggle for a Just, Participatory and Sustainable Society. This should include:

a. evaluation of the implications for political-economic thought of the ecological crisis;

b. the theological, ethical and social evaluation of the meaning and conditions of work in a time of economic distress and rapid technological change;

c. the ideological implications of scientific theory in the social sciences, especially in economics and sociology.

5.5. *Theological Issues in Relation to Humanity, Nature and God*

The Central Committee approved the plans for a study seminar organized by Church and Society in cooperation with Faith and Order and DFI to undertake:

a. the organization of a consultation in Asia (and possibly in Africa) of religious thinkers,

* See page 51.

philosophers and historians of science as well as natural and social scientists to discuss the relation between religion and science/technology. This consultation should be organized in cooperation with the Conference of Churches of Asia;

b. to organize an international study seminar of Christian theologians, natural and social scientists, and historians and philosophers of science to examine the different Christian views on

i. the understanding of reality and the interrelationship of God, humanity and nature
ii. the nature of knowledge, the ways of knowing reality in science and in faith/worship
iii. the ways of changing reality and the nature of our Christian ethical responsibility.

The staff are requested to keep in mind the recommendation of the Conference at MIT that "a series of theological papers be produced to make theology understandable in scientific circles; and to correct the superficial accounts of the enmity between science and faith which sometimes influences textbooks and popular understanding in many countries, and, to display the more profound relations that actually exist between them."

It is also noted that the discussion of these questions in socialist countries as well as in the Orthodox tradition can make an important contribution to the discussion.

5.6. *Educational Implications of Science and Technology*

The Central Committee noted with appreciation the work begun with science students at the Conference at MIT, and generally approved the recommendations of the Conference as well as of the science students' own meeting on the need for the Churches to be concerned about the social and ethical dimension of science education. The Committee notes that *Church and Society will work with the World Student Christian Federation and the Youth Department of the WCC to promote interdisciplinary seminars and dialogue with faculty and students on the social responsibility of science.* The programme should also include similar seminars for theological students and faculty and Christian educators to promote understanding of the thinking and practice of science and the challenge this poses to formulations of faith and social ethics.

6. *Change of Sub-Unit Name*

The Unit I Committee considered the proposal for a change in the name of the sub-unit, as a means of avoiding the exaggerated expectations from the sub-unit. It was recognized also that the word "science" in the name of the sub-unit would facilitate contacts with the scientific community. The proposal for an immediate change to "Church, Science and Society" did not however meet with the approval of all, since it would limit the scope of the sub-unit with its long history and record. It is therefore recommended that the matter be considered again at the next Central Committee.

August 22, 1980

Of the ten section reports at the Conference Section VI, Energy for the Future, caused the most heated debate in plenary. Especially controversial was the recommendation to national governments for a five year moratorium on the construction of new nuclear power plants. (Recommendation B:8) This recommendation was accepted by the 1979 Conference and the 1980 WCC Central Committee. Here is the complete list of recommendations from that report. For the full report on Energy for the Future see Faith and Science in an Unjust World, *Volume 2, pp. 88-104.*

Recommendations of Section VI on Energy for the Future at the 1979 World Conference on Faith, Science and the Future.

A. We recommend to the Churches that they:

1. give high priority to the development of strategies for full participation in discussions and decisions regarding the energy issues within their membership, in ecumenical councils and in public;
2. insist that such participation include all classes and groups of the population with full access to relevant information and real involvement in the discussions and decisions through fair and open procedures;
3. arouse concern and conscience regarding energy decisions with specific consideration for the responsibility people bear as citizens, consumers and workers in all aspects of the energy sector;
4. identify ethical criteria by which the social impacts of energy technologies must be assessed and insist that in setting energy policy such criteria be given equal weight alongside technical and economic factors;
5. identify and utilize members with special knowledge and responsibility in the energy field who can help one another and others to be equipped for informed participation;

The Central Committee in session.

Credit: L. Bianco

6. involve such experts, along with those who have insight in the theological and ethical issues, in equipping church members for participation in critical and informed deliberations and decisions;
7. develop a climate of trust and critical self-awareness in which biases can be acknowledged and corrected, differences of opinion and conviction can be faced and conflicts be dealt with, thus facilitating a continuing programme of education, participation and choice;
8. develop education materials about the energy issue for different levels of church life which give people a chance to acquaint themselves with the discussion thus far, enter a process of honest and open dialogue and so make up their own minds about opinions to be chosen and decisions to be made;
9. engage in a constructive and critical analysis of the national and international energy policies of their own countries, engage wherever possible in open discussion with their governments about these policies and keep each other informed of both progress and problems in these efforts;
10. engage with people at the local level in projects which enable them personally and together to experiment with a life-style which makes appropriate use of the available energy sources;
11. endorse, promote, and support the use of the WCC "Energy for my Neighbour" programme through their agencies and congregations.

B. We recommend to all national governments that they:

1. study the actual use of all forms of energy in their countries and not only the consumption of commercially traded fuels;
2. base the forecasts of future energy demand on the real needs for different forms of energy in the different sectors, rather than on extrapolation from aggregates of past fuel consumption;
3. provide incentives for the most rapid possible transition to the just, rational and efficient matching of energy sources to energy needs;
4. ensure that scarce resources of capital and skills are allocated in the first instance to the development of systems that will, as soon as possible, efficiently provide energy in the forms really needed from renewable sources;
5. mitigate any severe injustices between different sections of the population which may develop during the transition to efficient and renewable energy systems;
6. limit the growth in combustion of fossil fuels as much as possible, using these fuels, especially coal, as bridging fuels in the transition to renewable energy sources over the medium and long term;
7. meanwhile, use existing nuclear power plants only to the extent, for the purposes, and for the time, that there is no better alternative;
8. immediately introduce a moratorium on the construction of all new nuclear power plants for a period of five years; the purpose of this moratorium is to encourage and enable wide participation in a public debate on the risks, costs and benefits of nuclear energy in all countries directly concerned;
9. not reprocess spent nuclear fuel to extract fissile material such as plutonium—except for separation of small quantities for research and medical applications—and not construct plutonium-fuelled reactors;
10. devise short-, medium- and long-term national energy strategies designed to achieve these objectives and which are mutually compatible;
11. at all stages of the devising and carrying out of such strategies, keep people fully and hon-

estly informed, and encourage the widest possible public participation through fair and open procedures;

12. cooperate with other governments in order to ensure that:
    a. rates of consumption of the world's remaining non-renewable fuels are reduced as quickly as possible;
    b. injustices between countries caused by the unequal distribution of the fuels over the earth's surface and by market mechanisms are mitigated through international agreement;
    c. pollution of the environment by excess carbon dioxide, radio-activity and other by-products of the consumption of fuel is substantially researched and kept to the minimum that is technically feasible and ecologically sustainable;
    d. all countries move, with all possible speed, toward the efficient use of energy from renewable sources;
    e. the trend to destruction of the earth's forests be reversed;
    f. there is international support to aid the autonomous capacity of developing countries for energy research and development and for self-reliant energy projects in the poorer areas of the world.

C. International Energy Saving Pledge

In order to encourage individual efforts for energy saving in addition to governmental and institutional action, we recommend the introduction internationally of a "Fuel Pledge," written in simple terms. We recommend that churches throughout the world, acting in concert or through national councils of churches, should cooperate where possible with governments and non-governmental organizations in publicizing the pledge and promoting signature among all people of good will. We hope that suitable publicity and simple explanatory leaflets will be forthcoming in each country.

We propose the following wording: "I pledge myself to save fuel and electricity at home, at work and at leisure and to help to make available more for those whose basic needs are not being met."

The WCC, through its programme "Energy for my Neighbour," is asked to coordinate the implementation of such individual and communal efforts (for a description of the programme see the WCC booklet *Energy for my Neighbour: an Action Programme of the WCC*, Geneva, 1978).

Statement on Nuclear Disarmament

The growing threat of nuclear war became a central issue at two recent major WCC conferences, the Commission on World Mission and Evangelism Conference, "Your Kingdom Come," held in Melbourne, Australia in May 1980, and the Church and Society World Conference on Faith, Science and the Future. Responding to an urgent call from both conferences the Central Committee enacted the following resolution at its meeting in August 1980.

The Central Committee heard the message from the Melbourne Conference which spoke of the "clouds of nuclear threat and annihilation" and that from the Conference on Faith, Science and the Future which reminded it that the gravest danger that humanity faces today is a nuclear holocaust. It is with a great sense of urgency that the Central Committee makes this statement.

Developments in the recent period have brought the world closer to the brink of a nuclear war. Unless the present trends are reversed or immediately halted, a nuclear war is now a distinct possibility. Many scientists are convinced that in the past year the hands of the clock have moved closer to the midnight of nuclear war.

The tension between the United States and the Soviet Union has increased. They have each developed and continue to develop new generations of ever more devastating nuclear weapons. The dangers inherent in the deployment of these weapons within Europe have been heightened by the NATO decision to base new missiles possessing counterforce qualities and exceptional accuracy.

In August 1980 the United States officially announced a new policy which contemplates a "limited" nuclear war. This has further raised the anxieties about a nuclear holocaust. The current weapon programme of the major powers, if not stopped, will pull the nuclear trip-wire tighter. The development of "nuclear war-fighting capabilities" will increase the hair-trigger readiness for massive nuclear exchange at a time when political tensions are increasing all over the world.

Many years ago the United States, the United Kingdom and the Soviet Union agreed to negotiate a treaty banning all nuclear tests. Regrettably no draft of such a comprehensive test ban treaty has been presented. Neither China nor France has indicated willingness to enter into such an agreement.

The deliberations at the Second Review Conference on Non-Proliferation Treaty currently being held in Geneva have highlighted the fact that the nuclear weapon

states which have signed the treaty have failed to fulfill their obligations under the treaty to start nuclear disarmament, thus undermining the credibility of the non-proliferation regime.

The Central Committee urges all nuclear powers to: freeze immediately all further testing, production and deployment of nuclear weapons and of missiles and new aircraft designed primarily to deliver nuclear weapons; start immediately discussions with a view to making agreements not to enhance the existing nuclear potentials and progressively reducing the overall number of nuclear weapons and a speedy conclusion of a comprehensive test ban treaty.

The Central Committee also urges an early ratification of the SALT-II agreement.

In view of the possibility of nuclear war, the Central Committee urges the Madrid Conference (on European Security and Cooperation) to decide to start negotiations on nuclear disarmament.

Guidelines for Action on Nuclear Disarmament

1. In adopting the Programme for Disarmament and Against Militarism and Arms Race, the Central Committee in January 1979 gave high priority to the issue of nuclear disarmament. The report from the Working Committee on Church and Society, following up the Science for Peace Resolution from the Conference on Faith, Science and the Future, has called for a "more striking style and high visibility programme." The Central Committee therefore urges member churches of the WCC to alert people in their countries to the urgency of the threat of nuclear war and to launch priority programmes of church action in opposition to the nuclear arms race.

2. The Central Committee requests Church and Society and CCIA to arrange jointly an international Public Hearing on the current threat to world peace with special focus on the increased danger of nuclear war, where authoritative witnesses can be cross-examined in an effort to assess the present situation; encourages CCIA to continue its efforts to contribute to broad public education regarding present danger of nuclear war; requests Church and Society to make approaches to bodies representative of the scientific community, its learned societies and institutions at international and national levels to discuss further the nuclear threat to peace and the role of science in bringing it to an end.

3. The Central Committee requests the General Secretary to set up a panel of leading scientists, statesmen, military experts committed to peace, and religious leaders to advise the WCC and the churches on issues related to nuclear disarmament, and to explore the possibility of having a World Day of Prayer and Action in opposition to nuclear war in cooperation with the Roman Catholic Church, other Christian organizations and other religions.

General Secretary Phillip Potter introduced W.A. Visser't Hooft, first general secretary of the World Council of Churches, at a Central Committee session in his honor. On the far right is The Most Reverend Edward Scott of the Anglican Church of Canada who is Moderator of the Central Committee.

Credit: L. Bianco

A Meditation

The following is a meditation given to the Church and Society Working Committee meeting in Stuttgart on June 1, 1980. Giles Ecclestone is Secretary, Board of Social Responsibility, Church of England.

The power of the wind grinds corn in this mill on the island of Mykonos. *Credit: M. Tzovaras, United Nations*

I said in a contribution to our discussion yesterday that we need to think historically—about what science is, what faith is. People's interests shift. Forty years ago an Anglican report was published entitled *Doctrine in the Church of England;* 4 years ago a further report was published, this time entitled *Christian Believing.* Attention had shifted from the content of faith to the activity, the business of faith. *What is it to be a man or woman of faith?*

If I try to answer this question I become positivist. I want to say 'Come and see; have a look.' To a person who asked me what faith was about, I would say: 'come and take part in a week-long meeting of Church and Society.' We have been people of faith living and working together. What stands out? Jonathan King described some of the scientists at MIT as 'critical activists'; and that is us. We have been critical—remembering the frustrations of MIT; facing the anxieties and sense of frustration of this week; the tension between our desire to see the WCC do something, and our awareness of the way in which financial shortages and organisational politics may inhibit it. Some of us may have had a sense of quiet despair at the incapacity of people and groups to see what we see—whether it is scientists, governments, or churches. We have struggled to pin down concepts as slippery as wet fish. (I can only express my sympathy to those of you who were operating in a language other than your mother-tongue.) We have lived with the sense of the ground moving under our feet, as we tried to think consecutively about the risks of nuclear war. All this, and the poor, and the pollution, and the projections into the eighties; 'fear and trembling' might be too strong a phrase, but we have lived with *anxiety,* and with *uncertainty,* and with *frustration.* It sounds like Paul's vision of the universe, in microcosm. But we have *lived* with it.

Just to make it worse, we have been reminded by Dr. Leuenberger that this *is* the character of the world today as a human entity. The stable state is now at an end. Any state of life we are going to live in, including our goal of a sustainable society, is a matter of *dynamic equilibrium*—an impressive phrase, but what it brings to my mind is walking down the central gangway of a British train travelling at high speed. We always knew that faith was not sight; we are now shown that provisionality is also an element in it.

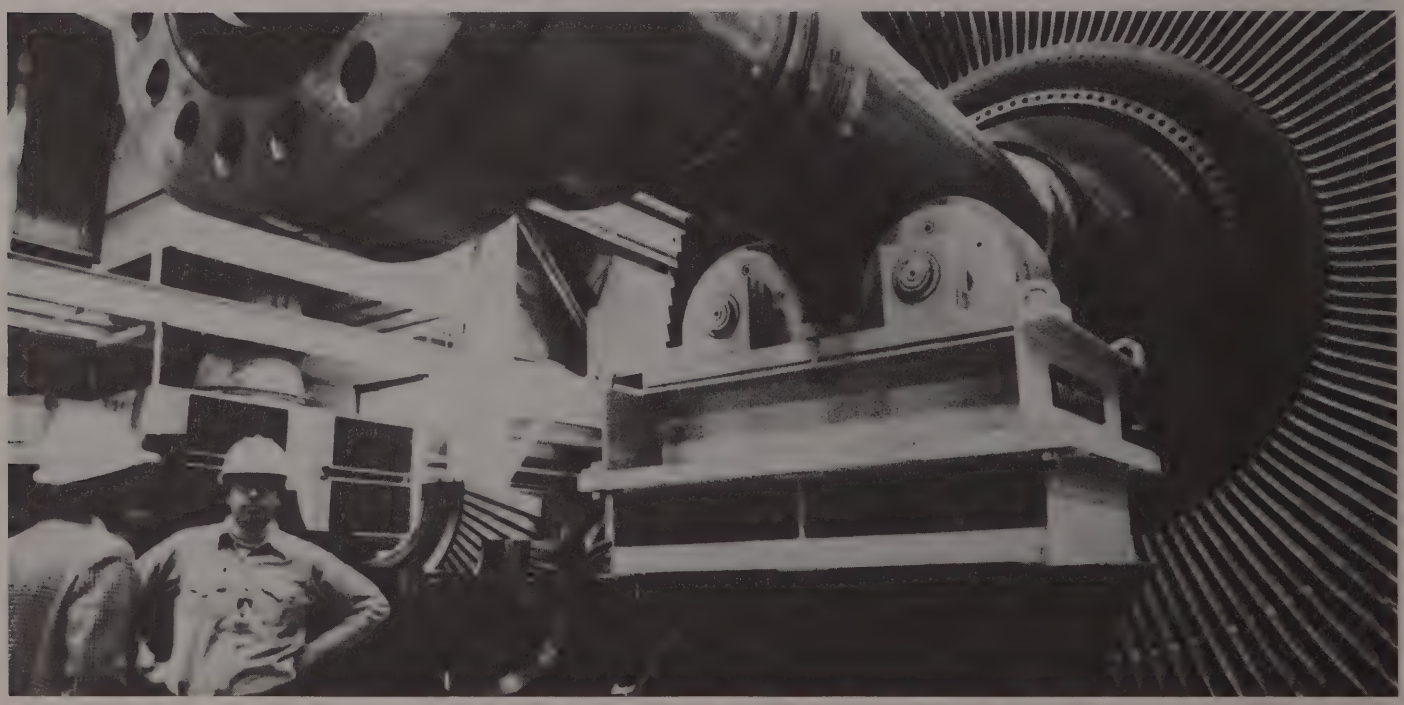
This is of course not the whole story about the business of faith. Hanbury Brown's language of complementarity in understanding reminds us that there is another side to faith too—joy, peace. But that's not my business now, nor has it been our business this week. I want to point to the fact—as it seems to me—that if we shift our attention from the activity of faith to one of the central affirmations of its *content,* namely that in Jesus Christ we see and respond to God's Kingdom, here also we find the need to live with provisionality, and in my experience the inevitable unsatisfactoriness of coping with the tension between the glimpses of the vision and the fragmentary and short-term responses—what we nevertheless grandly talk of in unguarded moments as 'bringing in the Kingdom.' This is not to say that we need be uncertain about the thrust of that vision. It is about human beings and their fulfilled existence in community, in a world which men and women are to receive, indwell and celebrate as God's gift. All our thinking about the just, participatory and sustainable society, like earlier WCC thinking about 'the responsible society,' is an attempt to bring coherence, wholeness, into our responses to that vision made in the particular situations and demands of the world as we know it. The responses themselves, whether it is a matter of working for a freeze on the nuclear arms race, or ways of grappling with rising levels of unemployment, must be systematic, coherent, and as related to the specificity of the situation as we can make them. Some of them will succeed, building for the time a more human habitation. Others may not. The most fundamental social transformations, as well as the smallest expressions of love, can be expressions of this faith in action, responsively revealing the Kingdom in the conditions of human life. What is true of Christ is true also of his Kingdom, however; it does not proclaim itself unambiguously; it can provoke negative as well as positive responses. The little bits of the Kingdom can just be exploited. The transnationals can draw on and if possible make a corner in appropriate technology if it helps them to stay in business. The vision at the heart of faith is always at risk of becoming unintelligible, or simply blocked out.

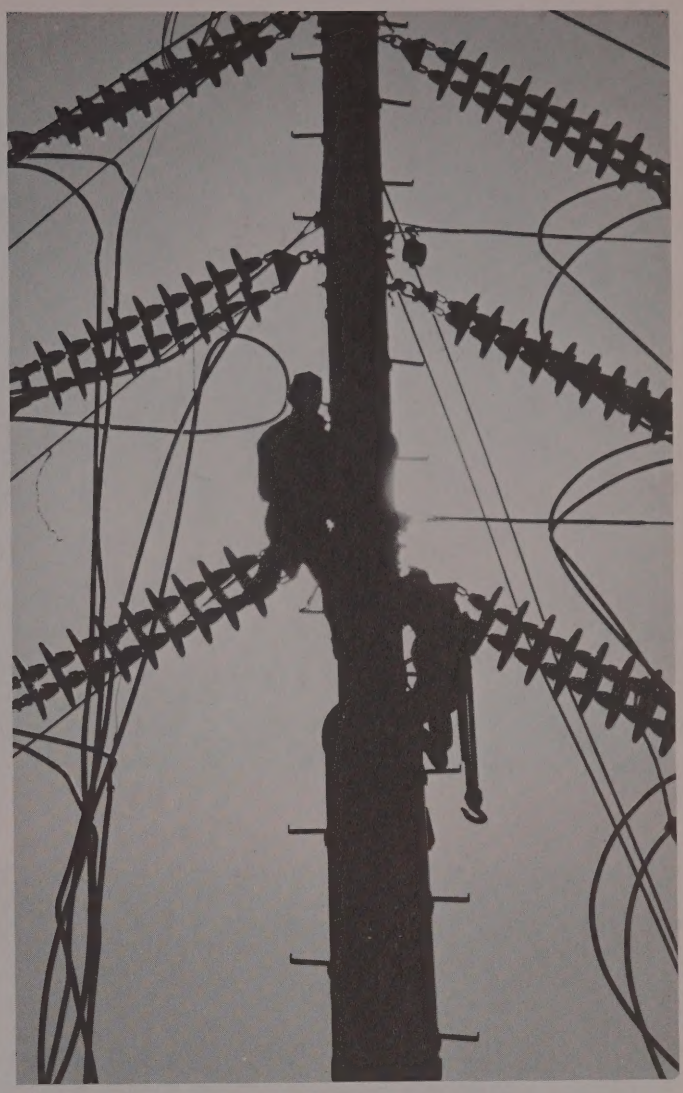
What all this points to is that faith, our faith, is not a matter of an ideal and untroubled commitment to a clearly-grasped perception of how the world is. Not only do we have to cope with a good deal of provisionality and anxiety in our living of faith, but in the strictest sense the world is not intelligible, as it stands, as the locus of the Kingdom. It is only as we work at the business of changing it that we come to understand it and perceive it as such. Vision, and provisionality—what we have been living through, and working on this week, is not an abdication of faith, but its expression. Someone—was it Augustine?—said, 'God has put salt in our mouths, and we now thirst for what we have experienced.' * It's an uncomfortable image of what we all know.

* Baron Friedrich von Hugel, apparently.

Giles Ecclestone is Secretary, Board for Social Responsibility of the General Synod of the Church of England. He is a layman and served previously as Clerk in the House of Commons. This meditation was given at a service of worship during the 1980 meeting of the Church and Society Working Committee in Stuttgart.

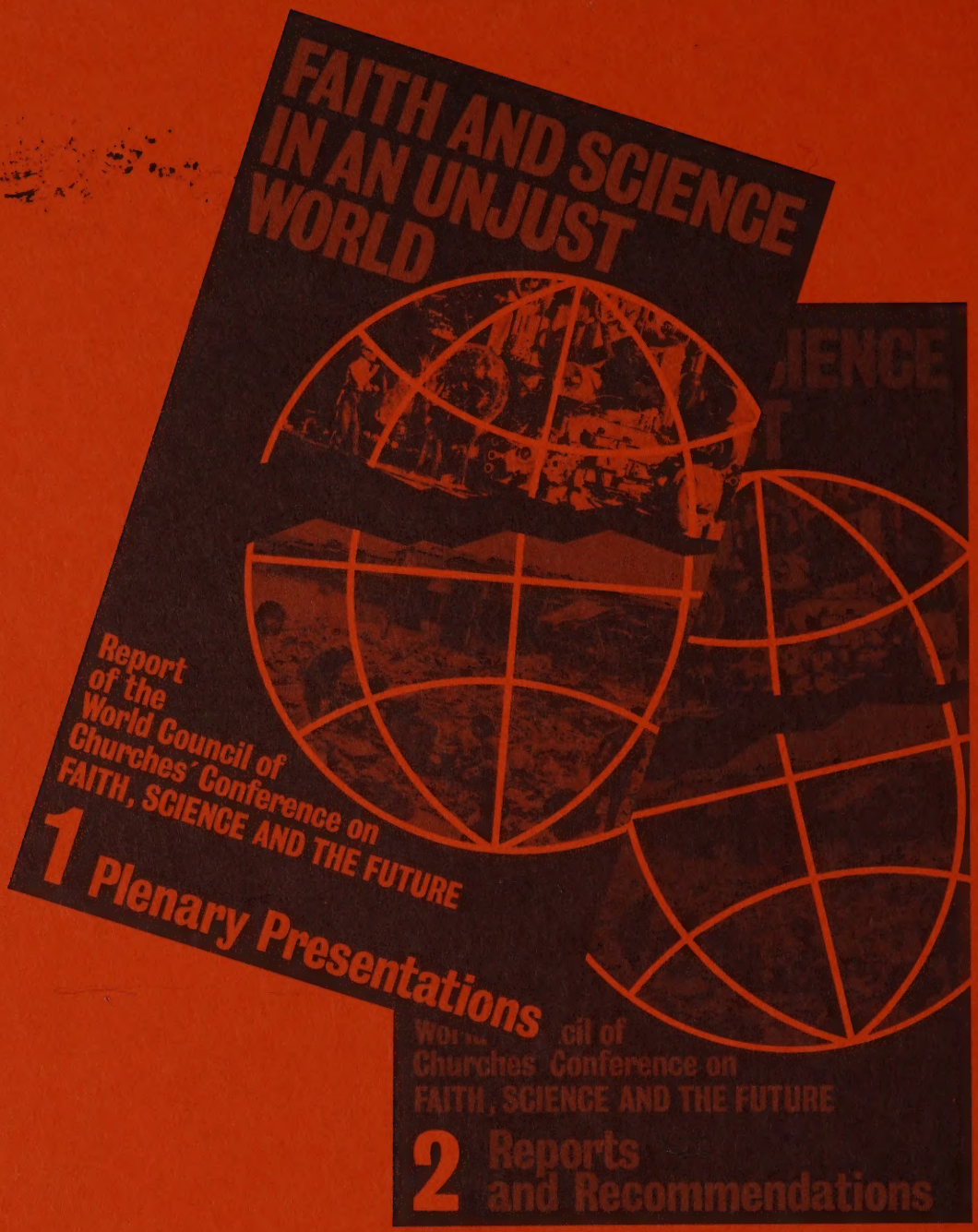
"In the search for the just, participatory and sustainable society. . ."





"... how is appropriateness in energy determined?"

Photo of Japanese refinery workers by Charlotte Saikowski, Christian Science Monitor. All other photos courtesy of United Nations.



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